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ERRATA.

Vol. VII. p. 101, line 21, *for* 7.5, *read* 7.25.
—— p. 176, line 2, *for* 23.24, *read* 24.6.

TO CORRESPONDENTS.

The Editor takes this opportunity of expressing his acknowledgment to Dr. John Gorham, of Boston, U. S., for his obliging letter, which, with the accompanying specimens from the United States, has only just come to hand, though bearing date "July 4, 1818."

Mr. R. Marshall's paper, "on an improved portable barometer," is not inserted, in consequence of the inaccurary of the accompanying drawing, which the Editor, not having seen the instrument, is unable to rectify.

The communication signed I. T——s, relating to Mr. Davies Gilbert's motion in the House of Commons, for an Address to H. R. H. the Prince Regent, praying "that His Majesty's ministers at the Court of Paris may be directed to take such steps, as may be most expedient for procuring the very valuable and important Logarithmic Tables, contained in the large manuscript of logarithmic numbers and measurements, calculated in France, and now extant in that country," is necessarily omitted, in consequence of the indistinctness of the decimals, which neither the Editor nor the Printer are capable of rendering intelligible. Had the author favoured us with his address, we should have troubled him with the correction of the press.

The letter signed VITRUVIUS would have been inserted in this number, had it been permitted to separate the *facts* from the *invective*. We are quite aware of the *cracking* or *explosion* of certain cast-iron columns, and *we* attribute it to an improper mode of casting, and not to any inherent property of cast-iron, that unfits it for those purposes to which we think it has been most judiciously applied. We can assure our correspondent, that the statements alluding to the Trafalgar or Southwark bridge, are not correct; the Architect of that magnificent ornament of the metropolis has, we are informed, long ago examined into the points which it is desired we should suggest.

THE QUARTERLY JOURNAL,

April 1819.

ART I. *Account of Batavia—Its Inhabitants, Commerce, Climate, &c. By the late* Dr. Gillan, *Physician to the Embassy to China, under* Lord Macartney.

[The following Account of the once splendid Capital of the Oriental Islands, now mouldering in ruins, and of its various inhabitants,—Dutch, Javanese, Malays, Chinese, &c., is from the pen of the late Doctor Gillan, who accompanied Lord Macartney to China, in the capacity of Physician to the Embassy. It will be read with the deeper interest from the lively description it contains of the manners and mode of life of a people "whose merchants were once princes, and traders the honourable of the earth." Of a people who, from the moment they deserted their Sovereign, and betrayed their allies, whom they had called to their assistance, fell rapidly from their elevated station, into the lowest depths of poverty and misery. Their foreign possessions slipt from their dominion; and Batavia, like another Tyre, saw the awful prophecy fulfilled: "Thy riches and thy fairs, thy merchandise, thy mariners, and thy pilots, thy caulkers, and the occupiers of thy merchandise, and all thy men of war that are in thee, and all thy company which are in the midst of thee, shall fall into the midst of the seas, on the day of thy ruin." It was but a few years before the fulfilment of this prophecy was realized with regard to Batavia, that Doctor Gillan drew up, on the spot, the account which we are now enabled, by the kindness of a friend, to lay before our readers. ED.]

BATAVIA, from the excessive heat of its climate, and the peculiar disadvantages of its situation, in a low fenny plain, surrounded with bogs and morasses on every side, has always been accounted one of the most unhealthy spots on the face of the earth; and the uniform experience of its fatal effects upon Europeans who have ventured to settle there, has abundantly confirmed the justice of the apprehension usually entertained against it as a place of residence. It is generally believed that it proves a grave to nine-tenths of the Europeans who remain there in the space of one year; and of those who survive, there is

hardly one to be seen who has the appearance of health in his countenance. A sallow paleness of face, a sickly languor of complexion, an emaciated look, and listless debility of motion, appear in every person. The inhabitants are familiar with disease and death. There is scarcely an example of a stranger's having remained long at Batavia without being attacked by fever, which is a general denomination here for illness of every kind, and indeed it is pretty justly applied. It is now well known in the medical world, that intermittent and remittent fevers derive their origin from those noxious vapours and exhalations which arise from fens and marshes, in warm climates and in warm seasons. And hence, countries and places where these abound, are always infested with these diseases; and the general terms of miasmata palustria, have very justly been adopted by physicians, as expressing the source of the causes which produce them. But Batavia and the adjacent country are, from their local circumstances, so particularly exposed to these miasmata, whose native virulence is intensely exalted by the thick humid shade of the trees and forests, which exclude the rays of the sun and refreshing breezes of the wind, that it does not at all appear surprising that such fevers, with all the train of their malignant effects, should prevail here in their most aggravated forms. Europeans soon after their arrival first become languid and feeble, and in a few weeks, sometimes in a few days after, are attacked by fever. At first it is commonly of a tertian type, which, after two or three paroxysms, becomes a double tertian, and then a continued remittent, which usually carries off the patient in a very short time. Many of them fall victims to the second or third paroxysm; but in these cases a constant delirium, and a great determination of the blood to the brain, are always observed. In some it begins in a quotidian form, with regular intermissions for a day or two, and then becomes a continued remittent, attended with the same fatal consequences as the former. In other cases, the fever from the first attack shows no intermission, or even remission at all, but marks its type by increased periodic exacerbations. Such cases are often mistaken for typhus, and almost always prove fatal; but, upon the strictest examination and the most careful inquiry I could make, it did not appear there were any well ascertained cases of typhus observed at Batavia. It

is very difficult, however, for a stranger, who remains here but for a few days, to get accurate information on any subject, much less respecting the nature, genera, and species of the diseases of the country; for the physicians and surgeons o Batavia, like the rest of the inhabitants, are adventurers, who were originally in very low situations in life, and never had the benefit of a liberal education, and much less of a proper medical one; they are totally unacquainted with the classification and distinction of diseases, and are almost entirely ignorant of the theory of medicine. Their practice of course must be entirely empiric, and appear very bad in the eyes of a regular physician, who is accustomed to proceed upon principles and experience together. The principal people, and those who can afford it, are attended, when sick, at their own houses, where the physicians go to see them. It does not appear, however, that they derive much benefit from their skill; and indeed from the circumstances above mentioned, there could be little reason to expect it. The use of Peruvian bark is little known amongst them; and when at any time they do exhibit it, it is in such small quantities, that no cure can be expected from it. There is no change made in the diet or regimen of the patient; and the chief, or rather the sole, remedy administered, is a solution of camphor in spirit of wine, of which a table-spoonful is taken occasionally in a glass of water.

When the fever does not prove fatal, and the patient's constitution resists it for a length of time, it becomes at last habitual or constitutional. In this manner it continues sometimes for several years, and, from long custom, the patient at last becomes so familiarized to it, that it is hardly thought a disease. In the intervals of intermission he manages his business, and goes out and pays visits, as if nothing were the matter. I had an opportunity of seeing a striking example of this while we remained at Batavia. One morning Mr. Maxwell and I went to pay a visit to Mr. Engelhart; he was in his cabinet and in his morning dress: the conversation turned accidentally upon the nature of the climate, the diseases of the place, and the frequency of death among the Europeans who settled there. "Il est bien vrai, monsieur," said he to me, "c'est un des plus mauvais climats qu'il y ait sur la terre, presque tout le monde meurt ici—mais moi, grace à Dieu, je me porte toujours

bien, et quoique je perde tous les ans la moitié de mes amis, je jouis toujours moi d'une très bonne santé ;"—at the same time he looked around him as if he wanted something. As he had promised to give me in writing a particular account of the Upas Tree, and as that was the principal object I had in view, I thought he was looking for pen, ink, and paper, to write. Accordingly, I brought them to him from the other end of the table, where they stood, and asked him whether they were not what he wanted?—" Point du tout, monsieur, je cherche un mouchoir ; c'est aujourd'hui mon jour de fiévre, j'ai eu un terrible accès ce matin qui n'est pas encore tout-à-fait passé. Vous pouvez encore en voir les restes sur mon front, et je voudrois avoir un mouchoir pour m'en essuyer la sueur ;"—at the same time he called his servant to bring him one. How, said I, Sir, a fever! I thought you had just told me that you always enjoyed good health. " Oh, Monsieur," replied he, " à ma fiévre près cela est vrai, mais je suis si accoutumé à cela que cela n'empêche que je ne me porte fort bien. Je sais que je dois en mourir un jour si je reste ici, mais j'ai déjà ramassé une assez jolie fortune, et je compte bien retourner en Europe avant que cette période n'arrive."

There are two public hospitals for the inferior sorts of people, to which they repair when they are taken ill. One of these hospitals is within the town, the other at a little distance without it, and situated on a spot of ground almost surrounded by water, which makes it appear like an island, and hence it is called the Isle of Purmerent. The hospital within the town is not reckoned so good as the other, and is therefore chiefly destined for urgent cases, or sudden accidents, which do not admit of delay, or time to carry the patient to the Isle of Purmerent, whose situation is considered as so much better, and so much more healthful. All convalescents, however, are sent there; their number is, indeed, very small, and the registers of either hospital record but few recoveries. Both these hospitals are under the management and immediate inspection of the governor and council of the Indies, who also appoint the surgeons and physicians, who are all here upon the company's establishment. The office of first physician to the hospital is a very lucrative one. He who held it last had been a common surgeon-barber, and employed for some time in the lowest duties of

his profession, in running from house to house, shaving beards and dressing hair. In process of time he came to be first physician to the hospital, and about eight months before our arrival he had returned to Holland with a million and a half of florins. His successor, the present occupant, was exactly in the same line with his predecessor, and has followed him with the same good fortune. He does not appear in any respect a man of abilities, and the gentlemen of the council themselves acknowledge that he is totally ignorant of the theory of medicine, and unacquainted with letters. But it is supposed he will retire in a couple of years, with a fortune equal to that of his predecessor; for it should seem this is the term usually allowed for one in his place to acquire a fortune. I had an opportunity of seeing and consulting with him upon Mr. Titsing's case. We met at Mr. Wiegerman's house, but as he neither understood Latin, French, or any language but Dutch, Mr. Titsing himself was obliged to act as interpreter. He could give me no account of Mr. Titsing's case, or indeed of almost any thing whatever, except the laws and regulations for the management of the hospitals. He could only tell me in general, that Mr. Titsing (whose disease I knew to be a tertian, from having seen him repeatedly under the paroxysms, and particularly at Mr. Wiegerman's country-house, where Sir George Staunton and I had gone with Mr. Wiegerman and Mr. Titsing the evening before,) had been long ill of a fever, as they called it; and that, according to their opinions at Batavia, the nature of this fever was to rot and corrupt the whole frame; that they believed, or were told, that camphor was the most powerful antiseptic in nature, and therefore it was their practice in fever, of which they were not accustomed to distinguish any difference or variety, always to give camphor dissolved in spirit of wine; that they made their patients take a table-spoonful of this solution from time to time in a glass of water, and this not only when they could do it, during the paroxysm itself, but also during the intervals. That for this purpose they recommended it to their patients always to carry with them, wherever they went, a bottle of this solution, and never to omit taking it. That Mr. Titsing was one of the most exact and regular patients, in this respect,

that it was possible to have; that he had never omitted his dose of it one day for some years past; that it was his constant companion wherever he went; that if any patient deserved to recover, it was Mr. Titsing; and that if he had not known, from long experience, how obstinate fevers were in Batavia, and how few ever recovered from them, he should have been very much surprised indeed to find he still continued to labour under it. However, he said, he observed with great satisfaction that, in spite of the fever, and all its septic tendency, the virtues of his camphorated spirit of wine had so far succeeded that Mr. Titsing was not yet quite rotten.

Mr. Titsing corroborated one part of the physician's story, by pulling out of his pocket his bottle of the solution, and taking a dose of it *more solito*. I ventured to prescribe to Mr. Titsing a different plan of cure, and encouraged much his idea of returning to Europe for the recovery of his health; and I doubt not if he complies with both advices, he will find them a more effectual cure than all the camphor in Batavia.

But if diseases are frequent and fatal here, it must be acknowledged that the manner of life of the inhabitants contributes as much to both events, as the climate and situation of the country. The same causes which render the place peculiarly unhealthy, contribute to make it one of the most fruitful spots in the world. It produces fruit and vegetables of every kind in the greatest abundance, and such a variety of spices and condiments as is not to be found in any other country. The ground is fertile, the climate enervating, and the inhabitants indolent, luxurious, and voluptuous. As soon as they get up in the morning, tea, coffee, and chocolate, are served up for breakfast, and fish, flesh, and fowl are placed upon a side-board, as if it were at dinner, and most of the guests partake plentifully of it. No sooner is breakfast removed, than Madeira, claret, gin, Dutch small beer, and English porter, are placed upon a table in the portico before the door of the great hall, and pipes, tobacco, and spitting-boxes, are brought for every body. Here they sit under the shade, drinking, smoking, and spitting, till dinner time. It is no uncommon thing for several of them to drink two or three bottles of wine before dinner; and

many of them who have prejudices in favour of their native country, take small beer, which they are told dilutes the blood, and affords plenty of fluids for a free perspiration; they sometimes drink from ten to fifteen bottles of it in the course of the day. They dine a little after one o'clock. Immediately before dinner two men slaves go round with Madeira wine, of which each takes a bumper, as a tonic or whetter of the appetite, and to give the stomach strength for digestion. This is always the signal that dinner is just going to be served up. Then follow three female slaves, one with a silver basin, with a cover of the same metal pierced with many holes; the second, with a silver jar full of pure water, and sometimes of rose-water, for washing the hands, and the third with towels for wiping them. When this ceremony is finished, the company walk into the hall to dinner, during which a band of music plays at a little distance. The musicians are all slaves, and in the number of these the master's chief ostentation seems to consist. Their dinners are plentiful, and consist of a great variety of dishes. They do not, however, eat much, nor indeed could it be supposed that in such circumstances they could have much appetite for it, but they seem to drink as freely as if they had tasted no wine that day before. At dinner a number of female slaves attend, and this seems to be the time principally allotted for their appearance. After dinner they wash their hands again, take a dish of coffee, and all go to sleep. Their beds, even in houses of the first people, have no sheets: they consist only of a mattress, pillows, a large bolster, and a chintz counterpane. They pull off their clothes, put on their night-dress, consisting of a night-cap, and long loose callico gown, which they always carry with them wherever they go; then lie down on the top of the counterpane, and so sleep till about five o'clock. Most of the gentlemen bachelors have a favourite female slave who retires along with them to fan them, and keep off the musquitoes while their master sleeps; but more frequently she performs other services. This however, is not tolerated in better regulated families, where a wife directs the internal economy of the house. They get up before six o'clock, dress themselves, take tea, and afterwards take an airing in their carriages, pay visits, and form

their parties for the evening, which they spend in various amusements, and never part till a very late hour.

Such habits of life soon exhaust the strength, and enfeeble the constitution. The functions of life are fatigued, the powers of the body are worn out by luxury, indolence, and voluptuousness; and, when disease attacks them, the feeble victim, without nerves or stamina to resist it, falls a speedy sacrifice, and sinks into the grave. Deaths of this kind are so frequent at Batavia, that they scarcely make any impression upon the minds of the inhabitants. The frequency of the event has rendered it familiar, and they shew no signs of emotion or surprise when they hear in the morning of the death of the person with whom they supped in seemingly good health the evening before.

There are but very few of the women of Batavia who have been born in Europe, most of them being natives of the place, but descended originally from European parents. The climate and manners of the country appear however to have had very considerable influence upon them, with regard to figure and appearance. The features and outlines of the face are European, but the complexion, character, and modes of life are very different, and approach more to those of the native inhabitants of Java. A pale sickly languor overspreads the whole countenance. There is not the least tint of the rose to be seen in any cheek. While at home in their own houses, they dress like their slaves. Their clothes are made of the same red checkered cotton cloth, and consist chiefly of a long loose gown descending to the ancles, with large wide sleeves. They have no head-dress, but they wear their hair plaited and fixed behind with a silver bodkin, in the same manner as the Paysannes of the Valais, and of several of the cantons of Switzerland do. The colour of the hair is almost universally black. They never use powder, but wear chaplets of flowers, and anoint the hair with cocoa-nut oil to make it grow. They certainly have great abundance of it, and very long and flowing, but whether the cocoa-nut oil contributes any thing to this effect or not, it always gives the hair a greasy dirty look, and has a very disagreeable smell. While they sit in this manner in the midst of their female slaves, dressed as they are, employed in the same occupation, and convers-

ing familiarly with them, a stranger does not easily distinguish them, and passes by without taking any further notice of them. A circumstance of this kind that happened to Mr. Maxwell and myself, embarrassed us a little. It was on the day we went to pay the visit to Mr. Engelhart, which has been mentioned before. Madame Engelhart, (who is the present governor-general's niece) and her daughter, by a former marriage, were sitting amidst their slaves in the portico behind the hall, and dressed exactly in the manner now described. After some conversation with Mr. Engelhart, we walked out to see the garden, stables, and other buildings behind the house; and we passed and repassed several times through the portico, without taking the smallest notice of madame or mademoiselle, whom we confounded with the group that surrounded them. We returned into the hall again; and were going to take leave of Mr. Engelhart, and go away. He said he must first present us to his wife and step-daughter. He went to the door and called them in. We thought we saw two slaves approaching before their mistresses; it was madame and mademoiselle, bareheaded, bare-necked, bare-legged, and bare-footed, clad in nothing but the loose red and blue-checkered night-gown. We made our bow, not a little surprised and embarrassed. The ladies curtseyed, spoke a few words to us, and then returned to their slaves.

When the Batavian ladies go abroad in the cool of the evening, to pay visits, or take an airing in their carriages, and particularly when they go to their assemblies or evening parties, they dress magnificently. Still, however, they put no powder in their hair, but adorn their heads with a profusion of diamonds and jewels of various kinds, intermixed with chaplets of flowers, and particularly the leaves of the *polyantha tuberosa* and *pandang*. They have very rich gold and silver boxes, in which they carry their betel and areca, and various spices, which they mix with it. They first take one of the betel leaves, and spread upon it a little slacked quick-lime and *gambir*, (which is the inspissated juice or extract of the cashew-nut;) they next take a piece of the areca nut, some bruised cardamom-seeds, pepper, and tobacco, and, placing this composition over the gambir and quick-lime, they roll it up in the betel leaf, then wrap the whole in one or two more fresh leaves, and so put it into their

mouths, and chew it constantly. This warm stimulating masticatory excites a flow of saliva tinged with the brown dirty colour of the gambir, which also overspreads their lips, teeth, and gums. Each of their areca boxes contains many small compartments for the different kinds of spices and other substances they make use of, and a knife, scissors, nippers, and other instruments for breaking the areca nut, and preparing it for being chewed. The ladies pretend the effect of these pungent fiery substances is to sweeten the smell of the breath, to strengthen the stomach, and give firmness and tone to the muscles and nerves. Each lady has a female slave or squaw that accompanies her wherever she goes, sits at her feet, and carries the areca box, and frequently prepares the quid for her mistress. In the parties or assemblies, when they find the heat disagreeable, they retire without any ceremony, undress themselves, put on loose cotton night-gowns, and return again into the hall, hardly recognisable by strangers. The gentlemen do the same, strip off their heavy velvets, and return in white cotton jackets, with loose sleeves. The *Edelherrs*, however, have generally diamond buttons to these jackets, and those a little advanced in years also put on their night-caps. Custom may reconcile these things, so as at last to make them appear indifferent, and especially in such climates as these, where every individual finds the benefit of a light loose dress, and pants for cooler air. But, with regard to the chewing the areca, it appears astonishing it should ever cease to appear disgusting to a European. Whatever real or pretended advantages the Batavian fair may derive from it, the appearance and practice are shocking and nauseous to a stranger; and instead of inviting passion, or increasing their charms, seem an invincible antidote against them.

This progressive change from the original European, and gradual approach to the complexion, character, and manners of the Aborigines of Java, would seem an argument in favour of the system of those philosophers who derive the whole of the human race from one common original stock, and make every variety of form, colour, and character, depend upon the influence of climate, local circumstances, and habits of life. Some of the wits of Batavia, however, pretend that the partialities and favours many

of the ladies have been suspected of shewing to some of their male slaves, might very possibly come in for a modifying share of this physical effect. Women here are generally nubile between eleven and twelve years of age. They are soon ripe, and as soon decay. A woman before the thirtieth year of her age is accounted a *femme passée.* After bearing one or two children their whole frame is relaxed and debilitated. The husband seeks for another mistress, and the slighted wife looks for another lover. It sometimes happens that a mutual tacit consent supports this double economy; but more frequently the passion of jealousy and indignant revenge prevails over every other feeling; and often, it is said, the furious spouse has administered poison to the husband, whose sudden death has been ascribed to the usual violence of the malignant fevers of the country. It appears certain that the climate is by no means so fatal to the female sex as it is to the male. Women live much longer, and are more exempt from disease. There are many examples at Batavia of one woman having outlived six or seven husbands; and in general most married women there have passed through several widowhoods. The mistress of the hotel where we lodged had been six times married before, and the present landlord was her seventh husband. There was every reason to conclude from her *embonpoint* and healthier look, compared with his thin emaciated form, that she stood a fair chance of soon changing him for another successor. There are, however, several causes which contribute to this effect, and that account physically for the longer life and better health of the women in this country. The greatest number of them, though originally of European descent, are natives of the place, and naturalized to the climate and manners of the country. They accommodate themselves from their infancy to the situation in which they are placed. They lead a life of ease and quiet; they continue all day under the coolness of the shade, never stirring abroad or exposing themselves to the heat of the sun, or the action of those noxious miasmata which perpetually float around the country. They take no concern in business or commerce, and of course live unmolested by the cares, anxieties, and concerns of trade and public affairs. They make frequent use of the cold bath, and are

much more temperate in eating and drinking than the men, who in general ruin their health and constitutions by excessive indulgence in both these respects.

There are six different kinds of inhabitants in Batavia and its environs, quite separate and distinct from each other:

1st. The Dutch and Europeans in general, who have all the power, offices and employments in their own hands, and exercise authority over all the rest; and whose perishing numbers are annually recruited from Europe.

2d. The Portuguese descendants of the first occupants of Batavia. They have now lost all commerce and connexion with their mother country, and have only a corrupted dialect of the Portuguese remaining amongst them. Even this, there are many of them who hardly understand; and all more willingly and readily speak the Malay language. They dress like the native Javanese in every respect, except that they wear their hair still after the European fashion. They have adopted almost entirely the manners and customs of the Javanese, from whom they are chiefly to be distinguished by the darker colour of their complexion and skin, by their having longer noses and sharper features of face. They are no longer Roman Catholics, but have all become Lutherans. They are all of them employed in the lowest menial capacities; a few of them are artificers and mechanics, and some of them live entirely by hunting in the woods and forests. They are indeed, the only chasseurs in the place. In short, they have nothing European or Portuguese about them except the name.

3d. The native Javanese. These have a peculiar colour of complexion that easily distinguishes them from all the other Indians and inhabitants of the place. They are neither so swarthy as the Portuguese, nor of so yellow a tinge as the Malays in general. Their features are fuller, their eyes large, their noses broad and flat, and their faces large. They are all free, and it is stipulated by treaty with the Dutch, that they must not be made slaves. Their dress too is different from that of the other Indians. They wear their hair in the manner already described, ·aited behind and fixed with a silver bodkin, which is the common ion here for women of all ranks and conditions. But their

necks, shoulders, arms, and a great part of the breast and back are quite bare. The men indeed, are usually naked from the waist upwards; but the women have a kind of wrapper which just covers the breast, and so passing obliquely downwards and backwards to the ancles; they cover themselves with a piece of the red and blue cotton cloth, folded in form of a petticoat. This dress they consider as a privilege to distinguish them from the slaves, who are never permitted to wear it, even after they are made free. Female slaves, however, are dressed in a much better, and much handsomer manner; and although the form and fashion be uniform with respect to them all, some of them, who are more handsome or greater favourites with their masters than the rest, are clothed in a much finer manner, and adorned with abundance of toys and trinkets. Their dress consists, first, of a white cotton jacket loose at the neck, and with a frill of lace round the opening of the breast. The sleeves are made to fit tight and reach down to the wrist, where they fix them close with a button; round the wrists they wear every kind of toy they can procure. Several of Mr. Wiegerman's had many such of gold and silver, and various coloured stones. This jacket sits close upon the body, and descends below the waist. Round the waist they wear a kind of double petticoat, reaching down the leg almost to the ancle. The petticoat is composed of two pieces of the checker cotton cloth. The one piece is brought from behind forward, and almost meets on the forepart. The other piece resembles an apron, and is put on the contrary way, passing from before backwards, but it is much narrower than the former and does not meet behind. As this kind of double petticoat has no spare cloth, and is drawn very tight round the waist, it shews the figure and shape. The price of slaves varies according to their age and figure but when they are handsome they cost from 400 to 500 dollars.

4th. The slaves. They are very numerous, every one having as many as he chooses, and can afford to buy and keep. There are many more female than male slaves. They are brought here from all parts of India, and it is remarked, that at all times, even in themselves and their descendants, the original

character and habits of their country may be distinctly traced. Those from the same places or countries associate with each other in preference to the rest; and, it should seem, they encourage and give examples to each other in keeping up pertinaciously the early habits and impressions of their native land. The dress of the female slaves has been already described. That of the males is more humble and simple. It consists of one long gown, reaching from the neck down to the ancles. It is of the same red and blue striped cloth entirely close, excepting an opening at the top for passing it over the head. It has closer sleeves which are buttoned at the wrist, where they too sometimes wear a few ornaments, and always they have several small yellow buttons at the collar. Each male and female slave has particular departments and particular services to perform, and these only they attend to. Hence the great number of both always employed and thought necessary in warm climates, and particularly in eastern countries; these slaves have each an allowance of a certain quantity of rice, and about the value of one penny sterling, in Dutch money, per day. They dress their rice in their own manner, and with the penny they buy fish, which they mix with their rice for their ordinary diet; if they choose vegetables they are commonly allowed to take as much as they want from their master's garden. Even from this scanty pittance, there are several examples of slaves who have subsisted themselves, and saved at last as much as was necessary for paying letters of liberty, when they have obtained their freedom.

Although the children of slaves are here, as in other countries were slavery reigns, the property of their masters, yet this source seems to afford but a very small number. The master chooses rather to buy than to rear one. Female slaves are reckoned hardly good for any thing after bearing a child, but for nursing and bringing it up. I saw one or two of them so employed at Mr. Wiegerman's. They looked old and worn out, yet I was informed they were young. They seemed to have no task but the care of their child imposed upon them, and I was assured they had nothing else to do. It is looked upon in these circumstances rather to be a loss than an advantage, to encourage matrimonial

connexions between the slaves, and accordingly it is discouraged, and as much as possible prevented; nor does it appear that the males are much disposed to press the matter. They are in general, lazy, languid, and feeble; the low diet on which they feed, and the indolent, unanimated, discouraging life they lead, give but little stimulus to passion. It should seem too their propensities to gallantry are never strong, nor are the exciting objects within their reach peculiarly calculated for calling them forth; unless it be in those cases where their kind mistress has chanced to cast a favouring eye on some happy individual, as the master often does on the female slave that pleases him. The fifth class consists of freed slaves and their descendants, who all continue free in virtue of the liberty of their fathers. The number of these is not very great, but they are manumitted from time to time by their masters, for various reasons: sometimes on account of long and faithful services, sometimes for particular actions meritorious in the eyes of their masters, or particularly acceptable to them; at other times, when their master, having acquired an ample fortune, is about to return to Europe, and hardly thinks it worth his while to sell them again; but most frequently when he is about to die, and then from various motives, chooses to liberate his slave. The slave so manumitted is obliged to have his liberty confirmed by letters-patent from the governor and council of the Indies, and for these letters he must pay a tax of twenty-five dollars. This sum the slave has sometimes accumulated himself from the savings of his daily allowance from his master, and sometimes the master also pays it for him. But it often happens that he neither has it himself, nor does his master choose to pay it for him; in this case the master engages him to serve him for a stipulated time longer, most frequently, I was told, two years; at the end of which period, if the slave has still continued to behave well and please his master, he then confirms his liberty and pays for his letters-patent, ascertaining his manumission. But should he behave amiss, or unfortunately displease his master, he then retracts his promise of liberating him, and keeps him in his former condition of servitude. When masters are cruel, severe, and otherwise maltreat their slaves, they are sometimes in considerable danger from their revenge; and

there have been examples of masters having more than once been murdered by them. But in general they have nothing to fear; and to masters who use them well they are said to shew uncommon fidelity and attachment. After they are thus liberated, the same principle of association with their countrymen prevails in full force. They seek for others in the same condition and from the same countries; they build little hamlets, and join together in the same occupations. Their usual practice is to hire a small spot of ground from the governor and council, or any of the servants of the company who have land to let. They convert these spots into gardens, where they cultivate fruit, flowers and vegetables, and carry them for sale to the market of Batavia, or to the Passai-Tannabank, the general market for such commodities for all the environs of Batavia, and even for all the district back to the Blewenberg mountains. This place is about five miles from the town; it is a small eminence about thirty feet higher than the level of Batavia, but being the only rising ground to be seen as far as the eye can sweep the plain around the town, it has been selected as a distinguished spot for a public market-place. Twice a week, on Mondays and Fridays, these freed slaves, and the other country people who live at some miles farther distance from town, bring their fruit, flowers, culinary vegetables, poultry, eggs, *&c.*, to this place. The hucksters, fruiterers, and green-grocers, meet them from Batavia, purchase their commodities wholesale, and carry them to Batavia, where they retail them in the streets and in their stands. I saw one of these markets, and could not help being surprised at the prodigious variety and abundance; but nothing struck me so much as to see large waggon and cart-loads of pine-apples, heaped up as turnips are brought to Covent-Garden. When they are sold here they hardly cost a farthing a-piece. We thought them exceedingly good, although the great abundance seemed to depreciate their value among the inhabitants. Whole fields of them are to be seen growing in the open air around Wiegerman's country-house, and all along the road-side for many miles, back towards the mountains. Even the fruit-sellers, who retail them again, and take their chance of those that spoil in the mean time, (which they readily do in this climate,) sold them to the ships for less than a penny a-piece

after carrying them from Tannabank to Batavia. *Tannabank* means in Malay, *Land of the Friends;* and such it surely is to the Dutch, who have their tables plentifully supplied from this as from a public store, and the market taxes into the bargain. Besides these articles, the freed slaves cultivate small fields of rice and tobacco for their own consumption; and they are the only people who cultivate the betel and areca, so much used here, and which, in the Malay language, they call *Siri* and *Pinang*. I was informed that these people, besides supplying the place, sold considerable quantities of these articles to the Chinese who trade between Batavia and Canton, where it is also much in vogue. But they get the gambir themselves from Malacca. It has been already remarked, that the constant use of the betel has a very disagreeable effect upon the lips, gums, and teeth, in the eyes of strangers. But the dirty brown colour it gives their teeth does not affect the enamel. It may be rubbed off, and then they appear quite clean, and very white. I saw this done repeatedly, and never observed any teeth spoiled by the use of it. There is another singular practice universal among all the natives of Java, and imitated by many of the free slaves, Portuguese, and Malays, which appears particular to this place. They grind down the extremities of the teeth in both jaws with a whetstone, till they have rendered them smooth and flat, so as that the junction, when they are shut, may be quite close or complete. This operation, I was told, was painful to them, but not by any means so much so as I should have apprehended. I saw the whetstones they commonly use, and found them of two kinds; one sort was evidently of lava, very compact and hard, found in the mountains of Java. The other kind was of the same nature as the common hone, and brought to them from Canton by the Chinese. Not content with this first operation, they cut a deep groove with a very sharp instrument of hard steel, quite across the enamel of the teeth of the upper jaw, and directly in the middle between the gums and the extremities. This they seem to consider as a very particular ornament, and what appears singularly surprising to a European, they suffer no inconvenience from it. The decay of the teeth, which we find occasioned from the exposure of the substance of the teeth to the free access of the air, does

not affect them here. However, there are several reasons that appear in some measure to account for it. In Europe such caries and decay happen indeed when the enamel is destroyed, and the substance of the tooth laid bare to the access of the air; but the destruction of the enamel is the effect of previous disease of the tooth, and the consequent destruction of the substance may be owing fully as much to the diseased action of the enamel, communicated to the substance of the tooth, with which it is in such close contact, as to the deleterious influences of the air. In this case there is no previous disease of the enamel, and of course no communication of it to the substance of the tooth. Besides, they live in a warm climate, and respire an atmosphere whose temperature is equable, and never subject to those vicissitudes of heat and cold, which particularly prevail in the northern countries of Europe, where diseases of the teeth are common. The food they use is not of the same putrescent nature as ours. They live chiefly on rice, and drink no fermented or vinous liquors. And the constant use of the astringent juice of the gambir, and the antiseptic qualities of the cardamom seeds, and other spices they use with their betel, may, in some measure, be supposed preservatives of the gums and teeth, and even to preserve them from the air, as they are constantly covered over with these substances. Although white teeth are reckoned a peculiar ornament by the natives of Europe, they are not so in the estimation of the Javanese fair, nor in the eyes of their admirers. Jet black is their favourite colour, and their standard of beauty for the teeth. It is a common phrase in all their mouths, "monkeys have white teeth, but we choose to have ours black." Accordingly they paint all their teeth in both jaws of a jet-black colour, except the two middle incisores, which they gild, or cover over with gold-leaf in each; and when the black paint or gilding wears off, they replace them both with as much care as the belles of Europe seek to purify and whiten theirs.

The Javanese and Malays, in general, are of a cowardly, but malicious and revengeful, disposition. They will stab or poison for the smallest causes, and many of them will commit murder for money. The common hire of an assassin among themselves is a

dollar, and it seems the crime is frequently perpetrated. It is common when they are much pleased or well treated by any one, to express their gratitude by offering to kill any of his enemies, or any person he may have a quarrel with; at the same time they contrive their measures so well as often to escape detection. Not long ago a Dutch clergyman was murdered in this way, about ten or twelve miles from Batavia, and the assassins never could be found out. Clergymen here engage in civil speculation as well as in theological studies. This man had taken a lease of some lands from the governor and council, and was thought extremely rigid by the Malay and Javanese tenants in collecting his rents; and, in revenge, they determined to murder him. He had a house on his farm, and a church close by, where he used to preach on Sundays. One morning, going to his church, he was stabbed in three places, and instantly expired. I was told this by a gentleman who knew the clergyman, and the circumstances of his murder. But, although they make so light of assassinations of this kind, they never attack openly, or dare to face an enemy who is aware of them. Ten of them would fly before a single European armed, and on his guard. It is this dread that keeps them so much in subjection to the Dutch. They acknowledge themselves that, were it not for their fire-arms and artillery, they would be in great danger, as they are more than a thousand to one against them. The sixth class of inhabitants are the Chinese, many of whom have settled here, and are engaged in trade between Batavia and Canton. They are the most active and industrious class of the whole, and carry on the greatest part of the business of the place. They are severely taxed, but still they find resources for paying them, and living comfortably. They retain the customs, manners, religion, ceremonies, character, and dress of their native country. They are great cheats, especially the merchants. I wanted to buy two or three yards of cotton-cloth at Batavia, and as I did not understand the language, the landlord of the hotel went with me, and conducted me to a Chinese shop, where I saw a small piece of about seven yards, which I would have purchased at a reasonable price. The Chinese woman (the merchant's wife,) who stood behind the counter, demanded thirty dollars for

it. I should have thought four dollars a sufficient price, and was much surprised at the extravagance of the demand. The landlord told me twenty dollars was the usual price of such a piece, and advised me to offer that sum. I replied that I thought it too dear, and should not purchase it at all, and turned towards the door of the shop to go out. The woman, observing this, offered the cloth for twenty dollars, then for fifteen, for ten, and at last for three. I went away, however, without buying it, and much surprised that the landlord should have advised me to offer twenty dollars for what, in his own presence, the woman at last offered me for three. I understood afterwards the landlord would have put the overplus into his own pocket, and paid the merchant only the just price; and it seems this is the common practice at Batavia, where the Dutch employ the Chinese to execute any business, or furnish any articles of merchandise, but receive the price themselves, paying the Chinese only a very small part of it. The Javanese have many singular customs and practices. They pretend particularly to a knowledge of herbs, and remedies of wonderful virtue and efficacy in the cure of all diseases, and to great skill in magic and fascination. In every country where diseases are frequent and dangerous, and physicians few and ignorant, empiricism prevails, and superstitious credulity in amulets and charms is carried to the greatest length. This seems to be peculiarly the case at Batavia, and the numberless deaths that constantly occur, notwithstanding all these infallible remedies, have not cured their confidence in them. The Dutch say, indeed, that they know neither the nature nor composition of these nostrums; that the Javanese only are in possession of the secret, and that they alone know the plants and simples whence they are prepared, and the forests or mountains where they grow, and that no temptation has yet prevailed upon them to discover them to any European. It is not surprising that such things should be credited and received amongst the ignorant vulgar; but at Batavia, men of the best sense and understanding in other respects are equally duped.

(To be continued.)

ART. II. *Letters on the Elgin Marbles, and the Sculptures of the Temple of Minerva at Athens; written in London, and addressed to* M. Canova *at Rome. By* M. Quatremere de Quincey.

My dear Friend,

YOUR letters from London, during your stay in that capital, on the Sculptures of the Temple of Minerva at Athens, (for the preservation of which, and the pleasure they afford, Europe is indebted to the ardent and enlightened zeal of Lord Elgin), together with the observations again addressed to me since your return to Rome, gave rise to a double impression, which I found difficult to explain. It was a mixed sensation of confidence and doubt. Unable, on the one hand, to suspect either your taste or candour, I felt obliged to admit the transcendant merit of those works; on the other hand, I knew not what secret motive it was, that inclined me to detract somewhat from the high estimation in which you held them.

The sight of these works, has not merely dispelled all my doubts, but, I imagine, revealed the cause of them; it seemed to have originated in a feeling of self-love, by no means unusual, which cannot patiently submit to a diminution or change of a settled opinion, respecting the absolute or relative merit of persons or things. It is a feeling, probably of the same character with that which at one time stimulates men to raise themselves above others, and at another time, to degrade their superiors; and becomes the main spring of emulation or envy according to the good or bad direction given it by the passions.

This spring is not less active in the sphere of erudition, talents, and science, than in the common circle of life, where the contest is for superiority in power, credit, riches, or rank. Let an individual proclaim that his researches have been more extensive than yours, that he has penetrated further into unknown countries than yourself, and has discovered wonders of which you have no conception; a slight feeling of envy, or an involuntary doubt as to the superiority of the objects he describes, will probably be excited in the minds of those who have preceded him

in the same path of inquiry. Such an impression is ever attended by good consequences. His rivals, either to dispute this pre-eminence, or to participate in the honour or pleasure of his discovery, will proceed to verify its reality, and subject his descriptions, his recitals and ooinions, to their own judgment and method of observation.

The same thing occurs with regard to the sensations of taste, and the ideas inspired by works of art and genius. He who has seen what others have not, provided the object be declared to possess some novelty or superiority, seems to arrogate to himself a privilege which will naturally awaken envy: if what he has seen be not merely an isolated, barren object, but a whole abounding in new points of view, and productive of opinions, to which a system of doctrines and theories might be annexed, still more naturally would self-love revolt at notions possessing a tendency to derange the result of those already established. Such observations as these, are by no means new to you. Here is the cause of the difficulty of establishing truth on more important subjects, such as matters of fact, not merely of taste; and of subduing opinions which, though false, have been nevertheless rooted in habits.

I believe myself to have been influenced in some measure by this caprice, when you imparted to me the sensations you had experienced at the sight of the Elgin marbles, which, at that time, were in a state of confusion. Much as has been lost of the relics of antiquity (and such has been the fate of its finest productions) we have yet derived from it so much that is excellent, which has been arranged in classes by the enlightened taste of several ages, that it was with difficulty I believed that such a scale could be disturbed by the works you mentioned.

Not that I wanted prepossession in favour of the sculptures of the Parthenon, which, to your knowledge, had engaged such of my attention eight or ten years ago, when I was intent upon discovering the composition of the western pediment of that temple, in consequence of a controversy that had arisen in the academy of *belles lettres*, about the side where the

principal entrance was, and the respective subjects of the two pediments.

Engaged also as I was in reviewing the great works of the statuary in gold and ivory, by a close examination of texts and monuments, (an idle project in the eyes of most men,) I had occasion to push my inquiries into a very remote period of the history of the taste and art of the Greeks. Having observed and proved, I trust, that the imitative arts must have been continually practised for at least three ages prior to that of Pericles; prepossessed in favour of that epoch by many analogies and parallels derived from other parts of the cultivation of the human mind; having elsewhere advanced that the ideal (comprehending this word in its true sense,) was the summit of perfection in the art, and convinced that the palm for this class had been already awarded to Phidias; you may believe I was strongly inclined to concede much in favour of works, that history proves to have been executed at least under the influence of the genius of that great artist, and which must bear witness to the taste and style of his time.

The Count de Choiseul-Gouffier had procured good casts of some pieces of the frieze of the Parthenon, and had brought an original fragment of it from Athens to France; from these as well as Stuart's engravings, I had imbibed a great idea of the sculpture of that period; and especially upon comparing it, as one ought to do in forming such judgments, with corresponding works, that is to say, with the merely ornamental parts of building.

But how are we to determine from these pieces, detached as they are from their body, and separated from the soul that animated them, an aggregate of facts and notions, from which may be derived a certain test of the science and taste of an epoch or a school? These fragments, as pieces taken from a frieze or series of figures in bas-relief, would at the most have served to give but a proximate idea of its whole. And it appears to me, that we should be mistaken even in this estimation, especially with regard to a work in which many hands had been employed, and which evidently presents more than one variety of manner and skill. Thus two or three Athenian females of the Choiseul marble, shew

a simple style of drapery, straight folds, and a proportion somewhat under the standard. Is it thence we are to draw a conclusion as to the general style of drapery and the manner of that epoch? The conclusion would appear the more erroneous, as it is belied by the work itself, and other female figures in drapery, which follow or precede those just mentioned. Similar errors will arise, if we pretend to deduce too general consequences, as to the science and skill of that time from certain negligencies of detail.

Thus, by taking pa ticularities for the basis of a general system, some critics may have formed and given to others very inaccurate ideas of the t ste of the time of Phidias. And, I believe, it was the fear of deducing, in a contrary direction, other equally inconsistent consequences from a few facts, too little known, and from too small a number of authorities, that kept me in that state of suspense.

Another cause of hesitation was, the idea that all the sculptures of the temple of Minerva were to be judged by that scale of proportion which relates to the degree of merit requisite for what we call decorative architecture, for we apply this name to every sculptured work, whether it adhere to the mass of an edifice, or form a necessary part of its architecture, and which is usually of secondary merit. It must be acknowledged, that this opinion is not inapplicable to certain parts of these sculptures, to those of the frieze for instance, and particularly the metopes.

Without ceasing to admire them, I clearly discerned from some specimens, in the manner of their execution alone, the object proposed by the artist, and the motives on which they had been produced; and in forming our opinions of them, these circumstances must be taken into consideration. I perceived, that to make a just comparison between them and other sculptures, known to have been executed for other purposes, and for nobler uses, we must take into the estimate every difference in the kind, destination, and execution. In fact, were we to appreciate the merit of some of our most skilful modern artists, from fragments either of decorative architecture or painting, which had been executed

under their direction, we should form the most imperfect notion of their knowledge and taste.

In this way I reasoned with regard to the sculptures of the Parthenon, and, in my opinion, not altogether erroneously. I was consequently inclined to form the best opinion of them, that is to say, to attribute to them a great relative perfection. Judging by analogy of the merit of the figures in the pediments, which I knew were statues, and not bas-reliefs, I was persuaded, that, in comparing them with our best antique statues, it was equally necessary to make allowance for the great difference of use and position. I considered that it required caution and restriction in measuring them with works designed for close inspection, and where a perfection in execution had been attended to, which adds to all the other perfections. In short, it appeared to me that the parallel should comprehend but a limited number of approximations, and only in those points which referred to character, style, and scholastic taste. Your letter, however, which apprized me of your having sent for a cast of the Hyssus, made me somewhat ashamed of my hesitation. You yourself had experienced the necessity of distrusting such isolated impressions as were the effect of examining works separately, and at a distance from their points of comparison. I feared that the same difficulties would attend an examination of the Athenian antiquities in London.

But finding that one of those objects which had been transported to Rome (the centre of all the parallels which could determine its worth,) maintained the rank you had assigned it, instead of losing by such a trial, I perceived that there must be a peculiarity in that sculpture; that is to say, a character and style of perception and execution imparting new ideas. About the same time, I saw at Paris a cast of the Theseus or young Hercules, a figure of the eastern pediment, and some other casts of different parts of those sculptures. It was really a kind of revelation to me. I immediately perceived to what errors we are led by all imaginary systems of the Grecian taste and art, when they are founded merely on a few incoherent and doubtful facts, which are but too frequently assumed as a complete body. The antiquities

we have appear to resemble, in their kind, what that translation of an old body of history would be, whereof three-fourths were deficient, and in which, besides the frequent errors of translation, you could not find two consecutive pages. With how much precaution should you make use of such a translation, were you desirous of filling up the chasms.

The sculptures of the Parthenon seem well calculated to fill an immense chasm in the history of taste; and, it is not to be denied, that unless such a fortunate transfer had taken place, neither the present effect, nor any other, would have been produced on the taste of the moderns; for, no one had yet expressed the hundredth part of what the cast of the Theseus alone taught me in a moment.

Such were my impressions, and I communicated them to you. You engaged me to examine the originals myself; I promised you I would, and have kept my word. I arrived in London the day before yesterday, and my first visit was to the British Museum. It would be useless to enter into detail on the subject to-day. I shall be able to say a few words at the most on the place where the sculptures which you saw in such confusion, are now arranged.

They occupy a very large room, built for the purpose, and lighted from above. All around it, a space of about eighty feet by forty, there is a row, within reach, of forty tablets, forming forty-six or forty-seven pieces of the bas-reliefs of the frieze of the Parthenon, most of which are four feet long, and some five or five and a half. Thus you will observe, you have a developement of nearly two hundred feet of this frieze; and you enjoy it certainly more than if on the building itself, where it was indifferently lighted, and situated at a greater distance from the eye. Add to this, that being placed around an interior instead of an exterior of a building, as was the case at Athens, the eye comprehends it, and reviews all the objects it contains with greater facility, and compares all its varieties the better.

Above the frieze, and at an elevation of nearly twenty feet on the longest sides of the room, are the metopes, in all sixteen;

but, in fact, fifteen only, because the sixteenth being a cast of one of the fifteen, is placed there for the sake of uniformity.

The statues of the pediments, and the principal fragments of the figures, more or less broken, in all about fifteen or sixteen, are arranged round the room, or fixed on revolving pedestals.

The smallest fragments, the use of which it is nearly impossible to discover, and others, which appear to belong to particular fragments, carefully collected together by Lord Elgin, and which may hereafter exercise the spirit of conjecture, are deposited around the walls.

I could not but admire this fine arrangement, and the wisdom that planned it. There could not be a better disposition for the several kinds of study and research. I must, however, impart a wish I had formed, the idea of which I took the liberty to communicate to Mr. Hamilton, in a slight sketch.

I conceive they have been perfectly correct in placing within reach of the eye, and in a manner under the spectator's hand, works which, from the mutilated state they must undoubtedly be left in, are to be considered particularly as objects for study. Nevertheless, I have been struck with the difference of effect produced by several of them, according to the variation of distance and elevation. Whatever might be said, all these objects, if seen in their proper situation and distance, would give certain lessons, and produce certain impressions, which the imagination could not otherwise receive. The British Museum possess fragments of every part of the architecture of the temple. I wish them to take casts of them; from one mould of a capital you will derive eight casts. In architecture you want but one fragment of the cornice, and one of the entablature, to form the whole of it. Nothing then would be easier than to construct, at the end of the Museum, in plaster or masonry, the front row of the columns of the Parthenon, together with its pediments; to place a portion of the frieze in plaster under this colonnade; to incrustate casts of the metopes between the triglyphs, and to occupy the tympanum of the pediment with casts of those statues which used to ornament it. Thus you would see, at a single glance, all those objects, both as they

were once seen in the work-shop, and in the situation and character assigned them by the artist. In the course of these observations, I shall communicate to you some other ideas, which the first survey of these masterpieces gave rise to. For it is insufficient that such objects as these gain the approval of artists only, they should likewise be so disposed as to win the admiration even of the ignorant; and whatever is done with that design, has more utility in it than is generally imagined. But I shall postpone these considerations to the following letters.

I should have liked to offer a remark or two on all the other riches contained in this museum. To speak the truth, I could only attend to the sculptures of the Parthenon. They alone, as you know, were the object of my journey; they only are to form the subject of this correspondence, agreeably to the limitations prescribed by you. Had there been no such conditions, you would not have wished me to describe objects you are acquainted with, and which have been already described very faithfully by Messrs. Visconti and Burrow.

I should, however, have preferred giving you the most ample description of all that is to be seen in the Museum, to hazarding the opinions and considerations you desire of me. To describe works of art, to class them, to give their proportions, to hazard an explanation of them, to attempt, by beautiful language and imagery, to convey an idea which cannot be expressed, is a work of patience, erudition, and imagination, and with a little of each of those qualifications you may satisfy many.

But you are not one of that number; you are an artist, and, as such, you wish me to treat of the sculptures purely as an artist. You desire me to communicate my opinion on that which constitutes their peculiar character and merit, whether absolute or relative; you wish me to apply a particular measure to each class of objects, in order to estimate them according to their different destinations, and to deduce such general consequences as will convey an idea of the whole composition, and of the genius which superintended these productions. You desire me to say what part I conceive Phidias had himself in the exe-

cution of this sculpture; what place the style of the epoch, and school, in which it was executed, should occupy in the parallel we are enabled to draw between their style and that of the other ancient works which remain to us; whether the taste of that age, from the authority of these fragments, ought to hold the rank which the testimonies of antiquity agree to allot it; what considerations are to be applied in comparing those fine productions of the ancients which have reached us, with the remains of the sculptures of the Parthenon; in short, of what importance, at a future period, will be the study and knowledge of these remains to the progress of the arts, and the developement of their history.

The task you have set me, contains more difficulty than I can encounter. It would form the subject of a great work. But such a work could not be undertaken at present: for one wants a previous concurrence of opinions, of judgments, and experiments, formed on the taste of a great many persons, in order to establish, in this perfectly new region of the history of the taste of the ancients, sure roads, and such points as cannot fail to distinguish the merit of a performance. The productions of taste or genius possess not in themselves those evidences which render proofs unnecessary; on the contrary, theories and truths of sentiment are founded on the impressions of the majority, and we have hitherto either been deficient in experiments, or they are not sufficiently numerous.

Judge, then, if I should not be guilty of an indiscretion, were I to treat fundamentally the questions you have propounded. But if you will be satisfied with a simple opinion, and that in the way of a correspondence, which you are at liberty to dispose of as you please, this is what I propose to do, in order to meet your wishes.

Whenever I come from the museum, I will commit to writing whatever the sight of the objects shall have suggested to me, at least in reference to those points, on which you were desirous of obtaining my opinion, and address it to you as a kind of procès-verbal.

I have made the arrangement only of the Athenian sculptures, amid the British collection, the subject of this letter; in the

succeeding ones I hope to communicate to you my sensations on the first survey of these great works. In excluding all other plans, and by simply pursuing the order of my impressions, I shall in the end present you with a sketch of what may become a work at a future day.

Art. III. *A brief Memoir of the Services and Proceedings of* Captain Webb, *Surveyor of Kumaon, collected from his familiar Correspondence.*

[There is not, probably, a body of men in any part of the world, or of any profession, who have greater and more frequent calls for the exertion of their intellectual faculties than the civil and military servants of the East India Company, dispersed over their vast possessions in Hindostan. Left to their own resources, and compelled to act on their own responsibility, many of them have displayed a degree of talent, judgment, and discretion, far beyond their years and limited education. As oriental subjects will occupy an occasional place in this Journal, we shall willingly introduce to public notice the merits of individuals, who are passing, or may have passed, the best part of their lives in these remote regions; and Captain Webb has considerable claims in this respect.]

Ed.

Mr. Webb was educated in the King's Ward, or Mathematical School, of Christ's Hospital; his mother, who is still living, having been left a widow with four children, two sons and two daughters. Though respectable, she was reduced to circumstances that did not admit of giving to those children such an education as she would have wished. The subject of this memoir, on leaving Christ's Hospital, was articled, in the usual way, to Captain Riou of the navy, then commanding the Amazon frigate, in which Webb sailed with him on two or three cruizes; but he was not with him when this gallant officer fell in the action before Copenhagen. Captain Riou had been prevailed upon, a little previous to that battle, to release Webb from his indentures, on being satisfied that he would receive an appointment in the East India Company's military service, which was likely to be more advantageous to him than his continuance in the navy.

In 1802, young Webb joined the second battalion of the third

regiment as ensign, then at Barrackpore. Though the Company's allowances are supposed to be very ample, yet, as in India persons of every rank and denomination live in as much splendour and extravagance as their means will allow, a poor subaltern generally finds himself considerably in debt on winding up his accounts with his black treasurer. Having no means but his pay, Webb had to struggle with many difficulties; but a few friends, which his cheerful and agreeable manners, his ability and good conduct, had procured, brought him through them all; and his only anxiety seems to have been the inability he was under to give assistance to his widowed mother, and to enable her to bring forward his younger brother.

In 1804, his prospects began to brighten by his promotion to a lieutenancy, and the hope that, through Lord Valentia, who kindly interested himself in his behalf, when on his travels in India, he might receive a staff appointment; but the application was unsuccessful. In the course of the war, however, which shortly followed, Webb's abilities began to be noticed. By the exertion of his mathematical knowledge, and its application to the duties of a surveyor to General Dowdeswell's division, in which capacity he was now acting, he had the good fortune to receive the approbation of the Surveyor General, who expressed his satisfaction in high terms at the execution of that part of the survey which had been intrusted to Webb.

The campaign being finished, Webb, who had always been accustomed to habits of industry, employed his leisure in the cultivation of music, and soon acquired a tolerable degree of execution on the most difficult of all instruments, the violin. In 1806, he was appointed to the temporary charge of a company of Sepoys; and the following year to the command of the escort which was to accompany Colonel Colebrooke, the Surveyor General, through the upper regions of Hindostan, who publicly expressed his great satisfaction in having a person with him so well qualified as Webb was to conduct a survey. The Colonel's health being unequal to the performance of a journey into the hills, Webb undertook it singly; he traversed the magnificent forests which skirt the hilly regions, and visited the great water-

fall on the Surjao river. But his zeal had nearly cost him his life, having caught a violent fever, in consequence of the fatigue he had undergone during the hottest season of the year in that burning climate. The native chiefs grew so jealous of his operations, that they issued orders prohibiting the inhabitants from rendering any assistance, or furnishing the necessary supplies; in consequence of which he was obliged to make long marches on foot, in a country where all Europeans are carried in litters.

When the projected journey was set on foot to ascertain the sources of the Ganges, Colonel Colebrooke was too ill to undertake it; but he assured the government, that " Lieutenant Webb was so well qualified to complete the survey of the ceded and conquered provinces, and having offered to perform the journey to Gangoutri, that he recommended him for that duty; in full confidence that, should the appointment of a surveyor be conferred upon him, he would acquit himself in that line entirely to the satisfaction of government." The result of this expedition is published in the Asiatic Transactions, under the name of " a Narrative, by Captain Raper."

Although this arduous journey had thrown him into a fever, from the effects of which he never recovered till he had visited England some years after, he proposed, in 1809, an expedition across the Himalaya or snowy mountains, with the view of ascertaining the exact situation of the celebrated lake of Manasarowar, which no European had then visited; a proposal which is stated by the Governor-General to be " highly creditable to his zeal and spirit of enterprise and scientific research;" but added, that the execution of it must depend on circumstances. This journey, however, it was found expedient, on political considerations, to abandon for the time; and the visit to the sacred lake fell to the lot of men far less competent to make use of so novel an occasion than Lieutenant Webb.

By the advice of his medical friends, he came to England in 1812, his health being so much impaired during the last three years, as to leave little hope of a recovery in India. In a letter from Lucknow, in 1810, he says, " I am not yet twenty-six years of age, and half my hair is white as silver."

While in England, he addressed an application to the Court of Directors to be employed as an astronomer, and to continue Reuben Burrow's work, accompanied by testimonies from Dr. Robertson, professor of astronomy at Oxford, and the astronomer-royal, which was referred to India; but his services were considered as too valuable to take him away from the Surveyor's department; and accordingly on his return he was nominated, in 1815, surveyor of the province of Kumaon. He was, at that time, serving with the army in the Ghorkhali or Nepaulese war; and his letters contain some curious traits of character displayed by the enemy to whom they were opposed; and particularly of the brave chief who commanded the army of Nepaul, and whose name was Ummar Singh. One of the letters of this chief to Nepaul was intercepted. The bearer of it, a Gosheen, threw away his bundle and fled; it contained, in addition to papers, a human skull with glass eyes. The letter, when put into an English dress, covered six sheets of foolscap paper. It displayed great ability; the style was noble and animated, and the sentiments such as would do honour to the greatest warrior and statesman of this or any other age or country. It discussed in detail the foreign and domestic policy of Nepaul, enclosed the draft of a letter to the Emperor of China, and urged the sovereign of Nepaul to a vigorous prosecution of the war; observing that, if he could but gain another success or two over Ochterlony, he was sure of being joined by the Sikhs. It appeared from this letter, that he had been instructed to treat for peace, and to sacrifice for the attainment of that object the Zuraee, the Doon, and the mountains west of the Jumna to the Sutledge. "But shall I," says this manly soldier, "shall I be the channel of such humiliating proposals? Rather select him who offered this advice; if you are so anxious for peace, you should have treated before your avarice prompted you to murder their revenue officer;" and he adds, "the English will attribute such shameful proposals to fear; and what reliance can be placed on a treaty framed under such an impression? For my own part I would rather die; I am old, but I put my trust in God and my sword."

Such were the sentiments of a man cooped up in a small mud fort, deserted by the whole country, destitute of supplies and all resources—and such were also the sentiments expressed, but in ruder language, in the petty letters of the inferior officers and soldiers taken at the same time; they desired their priests to pray for them, but breathed no word of fear or doubt. These brave fellows took the field, originally seventeen thousand strong, of which Lieutenant Webb says, not three hundred ever returned to Nepaul.

The battle which decided the fate of the Ghorkas, under the walls of Almora, is stated by Webb to have presented a scene of grandeur and sublimity far beyond the power of description. "The field of battle," he says, "was of no ordinary description; previously to the fight our camp occupied a ridge elevated five thousand five hundred and thirty feet above the sea; the loftiest post of the enemy six thousand four hundred and seventy-five feet, and the city itself five thousand seven hundred and ninety-two feet. The contending armies were separated by a river flowing in the bottom, the ford being depressed, below Almora, three thousand seven hundred and fifty-seven feet; to which, of course, we descended previously to our ascent to the attack. Amid such scenery the battle itself was grand beyond description." On this occasion, Lieutenant Webb acted as major of brigade, and received the thanks of Colonel Nicholls, "for having conducted the duties and details of that office with a degree of punctuality, judgment, and precision, which will ever stamp him in the commanding officer's opinion as a most valuable staff officer."

The termination of the war, and the great acquisition of territory, called for the exertions of the surveyor's talents. Having now completed his sixteen years of subaltern service, he became entitled, in the ordinary routine, to His Majesty's brevet, as captain. In proceeding through the mountainous and lonely districts, several of his instruments were lost or broken, and among the latter, two fine barometers, which deprived him of the opportunity of comparing the heights deduced from distant angles. "By giving," he observes, "a trigonometrical character to my survey, I have involved myself in such multitudinous computations, that I

hardly see my way to the end of my journey. My slate is continually before me, from the instant I rise, till I fall asleep over it at night." He writes from the neighbourhood of Askoth, on the Kalee or Gogra river, in lat. 29° 44′, that "the first snow fell upon a hill somewhat less than midway between that place and the Himálaya, on the 17th October, the nearest peak of the crest of those mountains being distant about twenty-seven thousand fathoms. Ten or twelve days after this," he says, "will bring the semi-Tartars, who inhabit Dherma, the province of Bootan, bordering on Askoth, to the neighbourhood of the latter place, 'with their wives and little ones, and household stuff,' being compelled to migrate every year, during the winter, to a more temperate climate. At this time, the inhabitants of the lower regions throw wooden spars across the streams for their accommodation, anticipating their arrival with as much anxiety as the St. Helena Islanders do the homeward-bound India fleet, and probably with the same feeling."

Towards the end of July, Captain Webb pitched his tent on the Peak above Uhree Deo; at which time, the rains were so very powerful and persevering, and succeeded by such heavy and continued mists, as entirely to interrupt the prospects of the survey. "I have now," he says, "been a week upon this peaked mountain, surrounded by woods and wilds, for some four miles on all sides, without having once been able to see the sun or a star; nor was it till yesterday morning, that I had an opportunity of using my theodolite. It must be allowed, however, that when the atmosphere does clear up, it does so most effectually; for instance, the parade at Almora is about sixteen miles and three quarters distant from me; and, with my glass, I could count every file at drill. Before the rains set in, the climate, however, is considered as delightful, the thermometer in the morning being generally about 48°, and at noon seldom exceeding 60°. In the middle of July, the trees were only coming into leaf; the rose-buds opening, and the grain about two inches above the surface; and I understand," he adds, "we shall celebrate harvest-home about Guy Faux's day."

In conducting this survey, Captain Webb thought it too good

an opportunity to be neglected for attempting to penetrate through some of the passes of the Himálaya. He accordingly sent forward from Dharma some Booteas to a station called Tuclahot, to apprize the Chinese or Tartar commandant of the nature of his employment in that neighbourhood, and to request permission to proceed on a visit to the sacred Lake of Manasarowar. The chief returned a civil refusal by his own messenger, intimating at the same time that he would make no objection to an interview. Accordingly Captain Webb crossed the snowy ridge by the pass of Lebong, in which the snow lay deep on the ground in the end of May. He found the chief encamped under a tent of woollen cloth, a number of horses and cattle grazing about, and surrounded by troopers with tails longer than those of their steeds.

The chief was seated on satin cushions; he wore a long loose damask silk gown, bound round the waist with a sash, and had a crystal button on his cap. He ordered pipes and sweetmeats to be brought, and tea mixed with clarified butter was handed round. He was sufficiently communicative, and Captain Webb learned that his immediate sovereign was the viceroy of Lassa, which is either a province of, or tributary to, China; that the distance to the capital of the same name was a journey of twenty days, and from thence to Pekin, of forty-five days; that the authority of the Emperor of China extended to Latak, which, however, was independent of China.

Thibet was a name unknown to him; and Captain Webb thinks it may have been derived from *Teiba*, which, in the Ghurcali language, signifies "high-peaked mountains," and which the old missionaries may very easily have transformed into Thibet. The country was unfit for any thing but grazing, and that only in the summer months: of course, the inhabitants migrate and live in tents. During the summer, numbers of travelling merchants pass over these elevated regions, on their way from China to Lassa, and from thence to Ladak and Cashmeer; the chief articles of trade being salt, borax, gold-dust, wool, pearls, and tea.

The meeting was perfectly amicable, and they parted, as the Deba said, "brothers;" but his fraternal affection would not allow him to grant permission to visit Manasarowar lake, which

was the more provoking, as they were then at the southern base of the Kylas, which alone intervened between Captain Webb and that lake. His orders, he said, were positive on that head; and that pilgrims even were, in future, to be prohibited from crossing the mountains; and when Captain Webb reminded him that two English gentlemen, (Moorcroft and Hearsay,) had obtained permission from the Deba of Gherthope, (named Gurdon by this chief,) he replied, that the Deba had been removed from his government, and ordered to Lassa to answer for his imprudence. On endeavouring to obtain from this officer some information respecting Manasarowar, he said, that upwards of one hundred streams fell into that lake; and that it had but one outlet, (frequently dry,) which connected it with the Rowan Rhad; so that Moorcroft's pundit, and the Lataki traveller, after all, were right, and Manasarowar is the source of the Sutledge. Captain Webb seems to think that the difference of levels of those two lakes must be considerable, and that a subterraneous communication must exist between them; as one periodical channel could not possibly carry off all the waters which are poured from the surrounding mountains into the sacred lake.

In this district bordering on Bootan, Captain Webb experienced severe snowy weather till the beginning of June; and, in the latter end of September, he was shut up for seven days by a fall of snow, which buried the adjacent country to the depth of two feet and upwards. The extreme fatigue, which the occupation of surveying necessarily requires in such vicissitude of climate, could not fail to impair his health; but his spirits remain good. In his last letter to his mother, he says, "That I shall ever be a stout, hale man, is hardly to be expected; and I think my visage looks more ancient and weather-beaten every time I consult a looking-glass; luckily, however, this is a monitor with which I rarely hold an interview. As I do not see a white face twice a year, my beard remains unshorn, and my general appearance is as wild and uncouth as that of my Indian companions. My face covered with hair, my body wrapped in a jerkin of Tartar cloth, and a fur cap on my head, I think that even you might pass me as a native mountaineer; and certainly so in the roads of this province,

where the eye seldom wanders further from the advanced foot, than the iron spike of a pole placed on the ground, which its following brother purposes to occupy."

In the course of this interesting survey, Captain Webb has taken uncommon pains to ascertain, by all the means that good instruments and trigonometrical operations could afford, the height of no less than twenty-seven peaks of the snowy mountains, the highest of which is stated to be 25,669 feet, and the lowest, 15,733 feet, above the level of the sea; the former being more than 5,000 feet higher than the peak of Chimboraço, the most elevated of the Cordilleras of the Andes.

It is to be hoped that Captain Webb will be induced to publish an account of his proceedings and observations in the upper regions of Hindostan, which now form a part of the British territories, and of which so very little is known in Europe.

(See page 51 *of our last Volume.)*

Art. IV. *On the Limit of Constant Congelation in the Himálaya Mountains.*

From recent inquiries and observations, of which the result has been the subject of a communication to the Asiatic Society at Calcutta, it appears that the inferior limit of perpetual congelation in the *Himálaya* range of mountains does not descend so low, as was to be concluded from theory.

The elevation of several stations, deduced from barometrical observations taken in June 1817, has been already given in a preceding number of this Journal, (Vol. vi. p. 64-65.) It was there remarked (p. 56,) that the elevation of the spot, where the *Gaurí* river emerges from the snow, had been found by measurement to be 11,543 feet above the level of Calcutta, (or little more than 11,650 feet above the sea,) in a parallel of latitude where the boundary of constant congelation might, according to theory, be expected at 11,400 feet. And a bridge of spars over the *Cálápání* river, or rather over the chasm in which it flows, two miles from its source, was found by geometrical measurement to be 12,670

feet above the sea; which would be quite conformable to theory, if the chasm were 1,200 feet deep.

Some inhabited places, (occupied, as is presumed, during the summer only,) were noticed, of which the elevation is from 11,050 to 11,489 feet above the level of Calcutta. These were concluded (*ib.* p. 57,) to be on the verge of the limit of congelation, as inferred from theory.

It was not supposed in these remarks, that the line of perpetual snow can be a well-defined, distinct, and precise one. The boundary of congelation must vary from year to year, with the mildness and severity of the season, and consequently must be taken for particular places, at a medium of a larger period. It must vary likewise according to the exposure of the spot. In a screened position or sheltered aspect, a deep chasm, or secluded cave, snow would remain at an elevation below that of more exposed situations.

Glaciers, as is well known, are perennial in certain situations, at altitudes much short of the prevailing line of permanent congelation in the same mountains. The glacier of the Rhone, immediately above the sources of that river, has been measured 1,842 French metres, or 6,044 English feet above the sea. The line of congelation in that parallel of latitude (40°,) has been stated from a table computed according to theory, at 7,402 feet.

A considerable latitude therefore is to be allowed for variance of particular observations, and for their disagreement with a theory expressed in empirical formulæ, grounded on no induction of ample facts.

Neither is it to be expected, that isothermal lines, which are far from corresponding to the parallels of latitude at a low elevation above the level of the sea, shall agree to precision with those parallels at Alpine, and more than Alpine, height.

These considerations are strengthened and confirmed by present information. Among the most elevated positions, of which the height was measured barometrically, as before mentioned, are the village and temple of *Milem*, 11,405 and 11,682 feet above Calcutta. That altitude, in the parallel of latitude assigned to the place, 30° 25′, would be near the verge of perpetual snow, and

even within its limit, according to theory. Yet the observer, Captain Webb, at the time of visiting this place, found extensive fields of buckwheat and Tartaric barley, occupying the space between the village and temple.

A twelvemonth later, on the 21st of June last, the same surveyor proceeding southward from *Jóshí-mat'h*, and from the *Daulí* river observed barometrically the altitude of a station in the ridge of mountains which he traversed south of that river. He found the height 11,680 feet above the level of Calcutta; yet his encampment, where the observation was made, was surrounded by flourishing woods of hoary oak, long-leaved pine, and arborescent rhododendron; and the surface was clothed with a rank vegetation of herbs.

On the following day, he reached the summit of a pass (*Pilgointi churhaï*) where he again observed with the barometer, and concluded from it an elevation of 12,642 feet above the level of Calcutta; (and consequently more than 12,700 feet above the sea.) A thick mist here confined the prospect, but no snow was to be seen contiguous to the spot. The surface exhibited a black soil, unless where the bare rock appears; and was clad with creeping plants and flowering herbs in luxuriant abundance. The shoulder of a mountain, on the one hand, rising still higher, was yet without a vestige of snow; and appeared, as far as the view extended through the mist, enamelled with flowers. A declivity, on the other hand, descended towards a forest of birch, pine, and rhododendron. In hollows and recesses, accumulations of snow were observed at a less height. But the snow, as was surmised, would probably be dissolved by the damp warmth of the ensuing rainy season.

The goat-herds of the country are accustomed, as they informed Captain Webb, to lead their flocks to pasture during the subsequent months (July and August) upon a yet loftier ridge of mountain, estimated to be as much above the pass of *Pilgointi*, as this is above the preceding day's encampment; that is, nearly a thousand feet. This information goes to remove the actual boundary of congelation still farther: and deserves to be verified, as proposed to be done, by again visiting the place at the specified season,

The road from the village and temple of *Milem*, before mentioned, towards Tartary, leads along the bank of a rapid mountain stream, and is evidently, therefore, a continued ascent. The snowy ridge is crossed by this route on the fifth day's journey from *Milem*, travelling with droves of laden cattle. It is passable in the month of July, at which season the carriers find pasture for their beasts of burden (sheep and goats) even at the fourth halt going from *Milem*, at a station which must consequently be taken to be considerably elevated above it.

Combining these corroborative circumstances, the limit of vegetation is carried by estimate to several hundred feet above the observed altitude of *Pilgointi* pass, and more than a thousand above that of the temple at *Milem*, or beyond thirteen thousand feet above the level of the sea, in the parallel of 30¼ degrees of latitude.

In a communication to the Asiatic Society from another surveyor, Captain *Hodgson*, who visited the remotest accessible fountains of the Ganges and Jamna rivers, it appears that the glacier and wall of snow, from beneath which the Ganges issues, was by him determined at 12,914 feet above the level of the sea.

The limit of constant congelation, then, may be reckoned in round numbers, either at 13,000 feet above the sea, in the parallel of 31°, as inferred from Captain *Hodgson's* measurement; or at 13,500 feet in that of 30°, as concluded by Captain *Webb*, from his observations. The former of these differs from theoretical conclusions, about 1,750 feet, the latter about 2,000 feet.

The recent barometric observations, which have been relied on, and which were taken in the month of June last, are as follows:

Crossing the ridge south of the *Dauli* river, on 21st June, at noon, barometer 19.63; thermometer, attached and detached 56½.

Summit of *Pilgointi* pass, 22d June, 1 P. M. barometer 18.96; therm. 54½°.

At the preceding station, the thermometer at sunrise, in the open air, stood at 48°.

The corresponding observation, assumed for the purpose of an immediate computation, was, bar. 29.58; therm. 84°, taken from a meteorological diary of the former year at Calcutta. It is subject to correction for an inconsiderable difference, between that

and the actual contemporary observations at Calcutta, when ascertained. The variations of the barometer are, in that climate and country, so limited and so regular, as to induce no risk of great error; and accordingly, on reference to diaries of antecedent years, the mean elevation of the mercury in the barometer, on the date of the summer solstice at noon, at Calcutta, appears to be 29,545; and the mean for the whole month of June is 29.56; the temperature being 83°. Greatest height, within a month before and after the solstice, at noon, 29.7; least height, 29.4.

The observer notices that he was actually in possession of five barometers in good order, one of them constructed by an eminent artist of London, and serving as a standard of comparison for the rest. The instrument, with which observations were made in the preceding year, was still in use, and agreed precisely with that test.

These barometrical measurements, it will be remarked, are but approximations. The possible errors, however, which can hardly exceed 100 feet, is very much short of the great amount in which the limit of perpetual congelation appears to differ from the theory.

In speaking of theory, that particular one has been here chiefly in view, which was given to the public not long since, as a result of certain experiments made with a delicate thermometer in a receiver of an air-pump. From theoretical data so obtained a table is computed, exhibiting the height of the curve of permanent congelation. Its extremes are, under the equator 15,207 feet; at the poles 0: and the height in the middle latitude 45°, is 7671 feet. The intermediate degrees likewise are computed, and from them may be concluded for the tropics 12,853 feet, and for the polar circles 2419 feet. The author of it has affirmed, that this table, though calculated from theoretical data, will be found to coincide with actual observation*.

Previous computations, founded upon observations which were discussed by *Deluc* and other writers, gave the height of the line of permanent snow differently, viz., under the equator, as actually observed at the basaltic summit of Pitchincha, half a degree south

* Supplement, Ency. Brit. iii. 191.

of the equator, 2,434 French toises, or 15,565 English feet. In the mean latitude, according to inferences from observations for France and Chili, 1,500 to 1,600 toises (or about 10,000 English feet), at or near the tropic, as at the Pic of Teneriff, 2,100 toises. At or near the polar circles 0 *.

Baron Humboldt found by observation, the region of perpetual snow commencing under the equator, in South America, 4,800 metres (15,747 feet); and in Mexico, he says, the eternal snows commence according to his measurements, in latitude 19° to 20°, at 4,600 metres (15,091 feet). The same intelligent traveller assigns the height of 2,550 metres, (8,365 feet,) to the line of permanent congelation in latitude 45° †.

I shall not stop to contrast these estimates and computations: but remark that observations of voyagers towards polar regions, and of travellers in Alpine countries, do not coincide with the assumptions of theory, and the tables computed from it.

Nor can it, consistently with experience and analogy, be expected, that one and the same scale shall serve both for northern and southern hemispheres, and for eastern and western continents; for solitary peaks, and for vast mountain-masses.

H. T. C.

January 1819.

Art. V. *An Account of a singular Case of Cough, cured by extensive Bleeding; in a Letter to the Editor, from* E. Brande, Esq.

The following case of cough which exhibits a rare combination of inflammatory and spasmodic action, may upon many accounts be thought worth recording. Cases of a similar nature are frequently occurring, therefore falling under the observation of medical practitioners generally, but neither my inquiries nor researches made at the time with considerable industry, furnished me with any instances at all parallel in point of severity and duration. It derives also additional interest from the fact of

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* Des Marets, Ency. Meth. Geo. Phys. iv. 69. 5.

† Political Essay on New Spain, i. 3, p. 74.

having been attended throughout its whole course by three of the most eminent Physicians of this metropolis, who either separately or together directed the treatment, as well as from the confidence and perseverance of the parties most anxiously concerned, under circumstances at times extremely discouraging, in consequence of the doubtful benefit derived from the powerful remedies which were employed, and the natural apprehension that the effects of these alone might be extremely prejudicial.

I have placed the dates and quantities of the several bleedings separately in a table, where they form a tolerably accurate scale of the severity and urgency of the symptoms, and do not interrupt the narrative.

E. BRANDE.

Arlington-street, February 1819.

A young lady, aged eighteen, of fair complexion, light hair, rather large and delicate person, enjoying generally good health, with every attention to its preservation, but subject to severe headachs, became ill in March 1809, with apparently common cough, and some oppression of breathing. It may be observed, that she had naturally an uncommonly fine and powerful voice, and was in the habit of practising singing some hours every day. After five or six weeks the symptoms, particularly the latter, gradually increased, so that any motion produced considerable panting, the pulse became larger and fuller than natural, the tongue was clean, there was no heat of skin, nor any other derangement of health; some remedies were now employed, and a spare vegetable diet was enforced, but the disease continued to increase; the cough was dry, short, very frequent, not violent; the difficulty of breathing great and constant; headach severe; and the pulse becoming hard, twelve ounces of blood were taken away on the 22d of May, from which she experienced considerable relief; this shewed slight marks of inflammation, and as the complaint continued, it was repeated on the 6th of June, and every two or three weeks to the end of July. At this time the principal symptoms were great sense of oppression about the chest, absolute inability to fill the lungs, the inspirations quick and short, from thirty to forty in a minute, each producing a short shrill cough. These came on at different intervals, from one to six days after each

bleeding: very slight at first, gradually becoming stronger, and ending in violent fits, amounting almost to suffocation; some hours of natural sleep were procured every night, during which the respiration was less frequent, and the cough subsided; there was constant palpitation of the heart, the pulse varying from 100 to 120, sharp, contracted, and rather hard; no particular heat or thirst, very little appetite; by the loss of from four to six ounces of blood, the urgent symptoms were immediately and regularly carried off, the pulse became more open, softer, and less frequent; relief was sensibly experienced, (even to bystanders) and a full and deep inspiration took place as soon as two or three ounces had flowed; and, in ten or fifteen minutes, the cough and oppression entirely ceased: upon this account the quantity of blood drawn was occasionally varied, but it was found that less than eight ounces did not produce an equal effect, nor was a larger quantity of greater benefit, it was always cupped and buffy; more so in proportion as the attack had been allowed to continue.

Things remained in this train up to the end of September, during which period what is called an antiphlogistic system was strictly pursued, and various medicines freely made use of; saline purges, antimonials, ipecacuanha, mercurials, camphor, opiates, henbane and hemlock, in full doses, with blisters, leeches, and the warm bath. The former symptoms were now somewhat mitigated, and those of catarrh came on, and went through their usual course, ending with expectoration, but had no influence upon the previous complaint*; the palpitation of the heart was always worse after eating, or when lying upon the left side.

October 24th. Foxglove has been taken during the last month; and for a fortnight, while the circulation was under its full influence, the symptoms were absent, the pulse being from forty to fifty, soft and irregular, the patient confined mostly to bed: upon leaving it off, they returned, but with less violence.

November 10th. There is less appearance of inflammatory action; the cough, still as frequent, resembles more the sound of a bell; one grain of opium with three of extract of henbane,

* This occurred frequently afterwards.

taken every two hours for four times have kept it quiet for thirty-six hours; upon its return, a grain and a half of opium, with three grains of extract of henbane, taken four times in six hours, hardly produced the same effects; and upon the third attack, fifteen grains of pure opium taken in twenty-four hours procured very little relief, and only about eighteen hours' sleep, without any increase of heat or appearance of inflammation.

November 22d. The mixture of myrrh and iron was given in doses increased up to two ounces, three times a day, and some animal food was allowed; by these her debilitated, pale, and almost bloodless appearance was improved, but the cough remained the same. A draught, containing fifteen grains of musk and five of extract of poppies, was afterwards taken three times a day for a week, without any sensible effect. From this time to the end of March, 1810, tonics and antispasmodics of various descriptions were employed, without any benefit: the original symptoms continued, with the addition of a fixed pain in the left side, and there was an evident falling-off in point of general health; bleeding was again had recourse to, with immediate relief; and as it continued invariably to remove the attack, it was desired that it should be repeated upon every accession before the symptoms became severe.

August 8th. The attacks have become less violent, and the intervals prolonged to eight or ten days; the pain in the side is nearly gone; the appetite and strength have increased, with considerable amendment in general appearance; pulse about 98, soft, and very little inflammation about the blood.

November 3d. The health continues to improve, and the interval between the attacks to become longer.

1811. January 13th. The cough, oppression, and pain in the side, return regularly after fourteen or fifteen days, but with less severity.

March 30th. Each successive interval is longer than the former, and each attack milder; the bleedings therefore have been delayed as long as circumstances would justify; a little animal food is regularly taken, but no fermented liquor.

From that time the health and strength gradually increased, for the last two or three years may be called re-established.

Some disposition to a cough of the same character still remains, but it is readily removed as before.

I have only to add, that leeches and blisters were applied most freely; changes of air, riding on horseback or in a carriage, were used during the summer months; rooms of regulated temperature during the winter; and throughout the duration of the illness, every possible care and attention which medical skill, or parental affection and anxiety could suggest, and the command of wealth supply.

A Table of the Date and Amount of each Bleeding.

1809.	oz.	1810.	oz.
May 22	12	June 27	10
June 6	10	July 5	8
—— 21	10	—— 16	10
July 5	8	—— 27	8
—— 26	6	Aug. 8	8
Aug. 2	10	—— 25	10
—— 5	10	Sept. 8	10
—— 9	4	—— 23	10
—— 11	10	Oct. 6	10
—— 17	10	—— 19	10
—— 20	12	Nov. 3	8
—— 24	8	—— 19	10
—— 28	8	Dec. 2	10
Sep. 1	8	—— 19	8
—— 6	10	1811.	
—— 9	2	Jan. 2	10
—— 11	10	—— [illegible]1	10
—— 16	8	Feb. 21	10
—— 19	4	Mar. 24	10
—— 24	10	Apr. 4	10
Oct. 24	6	—— 12	10
1810.		May 6	10
Mar. 26	10	June 9	10
May 2	10	July 4	10
June 12	10	Aug. 26	8
—— 20	10		

		oz.
1812.		
Jan.	22	10
July	12	10
1813.		
Jan.	9	10
——	27	10
May	13	10
Dec.	12	10
1814.		
Jan.	13	10
May	23	10
May	26	10
June	9	10
Aug.	25	10
1815.		
Mar.	6	10
Aug.	1	10
1816.		
Jan.	28	10
Nov.	26	10
1817.		
June	26	10

The consideration of the above case will readily suggest some inferences of practical utility; as such, I shall take the liberty merely to point out the intimate and persevering connexion which existed for so long a period between inflammatory and spasmodic action.

Without advancing any opinion as to the seat of the disease, or whether it originated in the vascular or nervous system, it is fair to conclude, from the very marked and regular benefit derived from bleeding, that the constitution required that relief, and most probably would not have borne the treatment, had not the absolute necessity for it existed.

From the perfect recovery of the patient, it may be presumed, that this was a disease of action rather than of structure; or, that if any organic mischief may have existed, it has been completely removed.

Art. VI. *On Useful Projects.*

Much ingenuity has during ages been devoted to the contrivance of methods for abridging human labour; and, in the prosecution of that important object, means were early devised, and have been in process of time successfully improved, for employing quadrupeds as instruments in the performance of work under direction of man: virtually, however, substituting them in

a great measure in his place; since the nourishment which they take, or the land that affords it, might else be applicable to his sustenance.

So long as population is scanty, there is nothing undesirable in that progress. By the aid of animal instruments, as by that of inanimate tools and machines, a workman is enabled to achieve more than could else be executed by him. But, when populousness advances, and begins to press upon the means of subsistence, it is to be wished that inventive genius should take a new direction to devise appropriate means of enabling men to perform the work of horses.

This has been in some measure actually the case in Great Britain. The steam-engine has become an implement of human work, by which the labour of cattle and horses is dispensed with for mills, hydraulic engines, and every sort of stationary and fixt machinery. Some progress likewise has been made towards the application of the same power to moveable machinery, as for draught of burden on railways, and for some other purposes; not to mention the steam-boat, which has but begun to supersede the employment of horses upon towing-paths; and the extensive use of steam-engines for impelling vehicles by land and water, on railways and on canals, may with confidence be anticipated as no distant improvement. Methods that suffice for navigable rivers, are not so well suited to canals; and those that serve for railways, are not equally adapted to high roads. But the difficulties are not insurmountable; and projects for those purposes have been started, some of which are not unpromising. It may not be economical to put a steam-engine on a tow-path converted into a railway, to take the place of horses in towing; nor on the footpath beside a public road, to drag a waggon on the highway; yet, other resources are not wanting for dispensing with draught cattle by substitution of locomotive machinery on canals and roads.

But, in the more important object of agriculture, this inverse course of devices for discontinuance of labour of cattle, and exclusive reliance on man assisted by inanimate instruments, is yet to commence. Hitherto inventive faculties have been racked to contrive ways of sparing human labour, and substituting cattle,

and more especially horses. Ingenuity has been directed not only to the improved application of cattle-labour in a walk which it has occupied from early ages, as ploughing and harrowing: but also to encroachment on the ancient province of man with engines drawn by horses for reaping corn, for making hay, for draining and ditching, and for various other rural work.

Earnestly desiring to see the current of invention turned, and to witness the introduction and general adoption of efficient instruments adapted to assist men in the resumption of their ancient functions, to the exclusion of horses, and perhaps dispense with these altogether, and enable men to delve the ground without need of plough cattle, I am solicitous of drawing attention to this object, as well on the part of those who are habituated to the exercise of inventive talents, as of those who are in the practice of offering prospective rewards for useful discoveries adapted to prescribed ends.

To ingenious persons, it often is sufficient to have proposed a problem. The solution of it is ensured by a steady application of their thoughts to the subject proposed. A trite remark is, that necessity is the mother of invention. It is so, because the attention is closely and unremittingly given to the object, in proportion to the urgency of the want. In course of meditation, under such circumstances, all possible modes within the compass of the person's knowledge are revolved. He calls up his experience; he tries its suggestions; he examines the resources of art within his reach; he pursues the clue which it presents; failing in one direction he turns into another, he invents means or devises expedients.

Eminent instances are not wanting of such complete success in studious research, as to authorize an opinion that discovery on any given subject may be confidently sought by fixed attention of fertile minds. Let the need be known, and art handled with science will furnish the means of satisfying it. On this account, the proposal of a premium for invention, or even simply a topic for investigation, is often of national benefit.

The problem, which it is the object of these observations to suggest for proposal, is to devise means of applying inanimate

power to field labour, which shall thus be performed at less cost than by horses; or to contrive tools and implements by which a man may be enabled to perform so much more work than he can do with implements now in use, as shall render him a cheaper labourer, comparing hire with performance, than a horse is.

The benefit expected to arise from the attainment of this object, may be explained by the following remarks:—

It was shewn, in a former Volume of this Journal*, that there is reason for believing the populousness of Great Britain to be in a state of actual progressive increase, even beyond the ratio which a comparison of the enumerations of 1800 and 1810 exhibits. The bills of mortality for 1818 go to confirm that opinion. The excess of births above burials is much greater than in any preceding year†. It has been progressively increasing. It is much greater in the octennial period than in either of the preceding octades; larger in the four last years than in the four first‡; larger in the very last, than in any single year which went before it. If the metropolis may serve for a sample of the realm, the increase of population in the past eight years is already greater than in the foregoing ten.

The population of Great Britain and Ireland, according to the census of 1810 for Great Britain, and by estimate for Ireland, was 16,000,000 in 1810. Add probable increase since that period, and the total population of the British isles may be now estimated at nearly 18,000,000; of whom a third, or nearly 6,000,000 of people may be considered to be employed in agriculture.

The consumption of oats and beans by horses has been estimated by Mr. *Western* and Dr. *Colquhoun* at more than ten or even eleven millions of quarters. The greatest proportion of the horses must be set to the account of husbandry. *Lavoisier* estimated in France six times as many horses for agriculture as for draught of carriages on high roads and in towns. Admitting the dispropor-

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* Vol. V. p. 305.

† Births to deaths 24,233 : 19,705 : : 1,242 : 1,000.

‡ 1811 to 1814 as 113 : 100.
1815 to 1818 as 12 : 10.

tion to be less in England, still it is very great: and if horse husbandry can be made to give way to human agriculture, the arable land, which is now devoted to raise beans and oats for nourishment of horses, (but sufficient, were the produce diverted from that use, for the subsistence of five millions of people,) as well as land producing fodder likewise allotted to horses, (but available, were they disused in husbandry, for purposes more directly beneficial to man,) Great Britain might with ease support an increasing population, without need of supplies of agricultural produce from abroad. It would with facility maintain a third or a quarter more people than it now does; for the corn annually consumed by one horse, exclusive of a couple of acres yielding him fodder, is ample provision for the subsistence of seven to eight persons*. His labour equals that of five men; but his food exceeds even that ratio. Now, if two men, with improved implements or machinery, may be enabled to perform the work of one horse, the cost of the labour being in that case nearly equal†, the Public will be benefited by an addition to the available population and national strength, in no small proportion to the vast increase of numerical population, resulting from the accession of seven or eight persons for every horse disused.

A venerable agriculturist has proposed a large experiment of spade-husbandry. It is not, however, likely that the experiment should be successful, without some notable amelioration of the implements of culture. The garden would long ago have taken the place of the arable field, and the spade have supplanted the plough, instead of the contrary course, which has long prevailed; were it true that, with implements now in use, manual labour could be rendered more profitably productive in husbandry than the work of horses.

* Allowing fifteen quarters of oats to a horse, and two to a human being, for the annual consumption of corn; besides the produce of two acres liberated, and made applicable to the sustenance of man. Fodder grows continually dearer, and can be worse spared, as a country advances in populousness.

† Reckoning hire of labour at fourteen shillings per week for a man, and the cost and keep of a horse at fifty pounds a year, besides the ploughman or carman to attend and drive the team.

But with improved implements it not improbably may be so; and the object well deserves most serious consideration and earnest exertions for its accomplishment, if by any means it be practicable.

The present deficiency of employment for labouring poor, and the consequent distress which is very generally felt in country places, would be instantly remedied by so valuable an invention.

That deficiency is, among other causes, to be ascribed to a change which has taken place in the progress of population, and which has rendered towns and even great cities independent of the country, and competent to keep up and greatly augment the number of their inhabitants, with no accession of people from without. Towns are not now a drain of population from around, but are ready to cast forth superfluous numbers abroad; while the country swarms with a growing people for whose increase there is no call.

In this state of affairs, he who should invent a mode of advantageously employing men instead of horses, would be justly hailed as a benefactor of his country. Toward this desirable object it is the purpose of the foregoing remarks to point the views of inventive genius.

Without presuming to chalk out a line in which success is likely to be attainable, it may be suggested that air is the mover which may be looked to with most confidence.

Among the various prime movers known to mechanics, animals are excluded by the conditions of the problem. Water, that is its current or descent, is so by the locality of this power. The more refined powers, which science might indicate, are for one reason or another, unpromising, as costly or as cumbrous. But air is present every where, and available, either without cost, as instanced in the windmill; or at little cost, by combustion of fuel, as in the steam-engine.

It might give a tone of ridicule to these lucubrations, were a proposal hazarded for a plough to be moved by wind; though perhaps it might be urged in defence of such a suggestion, that the Chinese have availed themselves of wind to aid the progress of vehicles on land.

With more seriousness a steam-plough may be hinted at, as no unlikely invention. It is, perhaps, more easy and obvious than the steam-waggon. Wheels, furnished with spikes or ragged fellies, being turned by a steam-engine borne on the carriage, might suffice to give it progressive motion. The ruggedness requisite to make wheels take a sufficient hold of the ground, to ensure progress, is no objection; as it would be in the case of a vehicle designed for moving on a high road. If the wheel of a plough cuts up the ground, it does but forward the operation of loosening the soil, which the implement is designed to effect.

For procuring progressive motion, whether of a waggon or of a plough, or any other implement, the steam-engine might be put horizontally, with the cylinder affixed to one train, and the piston to another: the admission of steam may serve to propel the fore-train, and the condensation of it to bring up the hind one; and both may be steered by an additional wheel.

This construction is, perhaps, liable to insuperable objections. The first mentioned, apparently open to favour, may possibly be unfit for the purpose, upon reasons not adverted to in this cursory view. Other more suitable forms may yet be devised and tried, and may not improbably lead to successful invention.

Let it not be objected that the introduction of machinery in agriculture would require a well-instructed peasantry; that the farmer must be conversant with mechanics; that his ploughman, his waggoner, must be an engineer. Competent instruction will not be wanting, if there be adequate reward for it. If machinery can be profitably applied to husbandry, persons will soon be taught the management of it, however refined the construction may be. If better tools can be invented than the clumsy and powerless spade and mattock, which have descended to us prescriptively unchanged, workmen will soon learn the use of them. The condition of the workman will be bettered, in proportion to the requisite dexterity, which, being acquired, will place him higher in the scale above the mere untaught labourer.

But, in truth, ingenious inventions do not always produce most complex machines. Ingenuity is now, perhaps, turned from complicated machinery to simpler contrivances; and, if knowledge and

genius be directed to the consideration of implements of husbandry, it may not be a visionary hope, that the proposed scheme of reverting to human labour in agriculture, and wholly excluding horses, may be made as practicable as it is desirable.

If any one should pronounce the scheme futile, let him recollect the wonderful improvement of machinery in modern times; let him compare the stocking-frame with the knitting-needle; and the mule-jenny with the distaff: or, if ludicrous images be acceptable, view a German professor mounted on a hobby; but acknowledge that a hobby may be converted into an expeditious vehicle for the traveller. In like manner some familiar utensil, perhaps bellows, may possibly furnish a motor of machinery. With this observation I leave the subject to the derision of those who may think the proposition impracticable and absurd; but to the graver reflections of such as may deem the object attainable, and the scheme of a ploughing machine not quite unfeasible.

C.

Art. VII. *A Memoir on the combined Agencies of Oxygen Gas and of Water, in the Oxidation of Iron; by* Marshall Hall, M.D., *&c.*

It has been generally supposed by chemists, that water, in imparting oxygen to iron, undergoes a decomposition, its hydrogen being evolved whilst its oxygen enters into combination with the metal. This decomposition of the water and evolution of hydrogen gas, have been represented as taking place slowly, at the ordinary temperatures of the atmosphere *.

It is the object of this memoir, to detail a series of experiments which appear to prove the incorrectness of this opinion; and to establish the fact, that, in the ordinary oxidation of iron by moisture or water, the action of the water is necessarily combined with that of atmospheric air, or of oxygen gas. The error appears

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* Davy's Elements, p. 385; Thompson's System, Ed. 5, Vol. I. p. 368; Henry's Elements, Ed. 7, Vol. I. p. 105.

to have originated in an inattention to this co-operative influence of the atmospheric air absorbed by the water, in inducing the oxidation of the iron,—to the changes induced in the atmospheric air itself,—and to the inaction of iron in perfectly pure water.

From the experiments to which allusion has been made, it is inferred that water is not susceptible of decomposition by the contact of iron, at the ordinary temperatures of the atmosphere; and that, when perfectly freed from absorbed oxygen, and secluded from atmospheric air, it is incapable of oxidating this metal. Oxygen gas, or atmospheric air, perfectly deprived of moisture, is also incapable, at ordinary temperatures, of inducing the oxidation of iron. This oxidation demands, therefore, the united agencies of water and of oxygen, the former appearing to constitute the *medium* merely, although a necessary one, by which the latter is seized and transmitted to the iron; or rather, perhaps, the presence of oxygen in the form of *hydrat*, is necessary for the oxidation of this metal. Thus, a bright plate of iron retains its lustre equally untarnished, in water deprived of its admixture of oxygen, and in oxygen gas, or atmospheric air, deprived of its hygrometric moisture; but it becomes quickly tarnished on being exposed to moist air, or to water containing absorbed oxygen.

I now proceed to the detail of those experiments on which these statements are founded :—

I. The first point ascertained in this investigation is, that water does not suffer any decomposition by the contact of iron, at the ordinary temperatures of the atmosphere.

Portions of iron plate were immersed in pure water in the inverted bulb of a common retort full of the fluid, and the apparatus was allowed to remain in this situation many days. There was not, however, the slightest evolution of hydrogen gas. The water appears, therefore, not to suffer decomposition by the mere contact of iron.

II. The next fact ascertained in these experiments is, that the portions of bright iron plate employed in them, remain untarnished, when the water has been previously deprived of oxygen gas absorbed from the atmosphere.

Water may be freed from its admixture of atmospheric air by long boiling ; but it may be deprived of any oxygen it may have absorbed, perhaps still more satisfactorily, as will be stated more expressly hereafter, by being subjected for some time to the action of iron filings, or of a number of bright iron plates. In either case, if portions of bright or polished iron be exposed, at an ordinary temperature, to the action of the water thus purified, the metal retains its lustre unimpaired. The water, therefore, does not appear to undergo the decomposition, or the iron the oxidation, hitherto supposed to take place in these circumstances.

III. But if, on the contrary, portions of bright iron plate be subjected to the action of water which has not been deprived of its admixture of oxygen or atmospheric air, their lustre is quickly impaired by oxidation.

If a number of bright iron plates be immersed in a quantity of water from the pump, their lustre is soon tarnished; and, if the atmospheric air have access to the superincumbent water, a reddish-brown oxide is formed ; but, if the water be secluded from the atmosphere, the oxide first produced is of a reddish-brown, but afterwards assumes a greenish-black colour ; and, in this latter case, if, after a sufficient lapse of time, fresh portions of iron plate be inserted, the atmospheric air being still excluded, they then retain their lustre unimpaired.

From these experiments it appears evident, that iron does not possess the property of decomposing water, at the ordinary temperatures of the atmosphere ; that this fluid occasions the rusting and oxidation of the metal only when it contains or has access to atmospheric air ; and that, whilst a seclusion of pump-water from the atmosphere occasions the formation of a greenish-black oxide of the iron exposed to its action, the admission of atmospheric air induces the formation of an oxide of a reddish-brown colour.

IV. The latter fact seemed, however, to merit further elucidation ; and it was found by the following experiment, that the reddish-brown oxide produced by the free access of air, became changed into the dark-green, when the air was excluded, and it remained in contact with the iron ; but that it retained its colour,

although the air was still excluded, when it was no longer in contact with the metal.

A piece of iron plate was covered with muslin *, moistened with water, and placed in contact with the atmospheric air, until a considerable portion of red-brown oxide was formed; the plate was then cut in two; one half was placed in a vial filled with water, which had been freed, and which was excluded from oxygen, the oxide and iron plate remaining in contact; the muslin and oxide were separated from the other half of the iron plate, and introduced into the same vial. The latter portion of oxide retained its colour, whilst the former gradually changed to a dark and deep green. The dark-coloured oxide again changed to the red-brown, when exposed in a moistened state to the action of the atmosphere, but remained unchanged if free from moisture.

Thus by the contact of iron and moisture, and the exclusion of oxygen gas, the red-brown oxide becomes the dark-green; by the contact of air and moisture, the dark-green oxide again becomes the reddish-brown.

V. If water taken from the spring contain portions of bright iron, it transmits to them the oxygen it may already have absorbed; it again absorbs a portion of oxygen from the superincumbent air, which is, in its turn, transmitted to the iron; and, when it is placed in contact with a limited quantity of oxygen gas, or of atmospheric air, the oxygen is successively absorbed by the water and conveyed to the iron, until at length the whole of the oxygen gas disappears, and in the case of atmospheric air, nitrogen gas alone remains.

If a jar, containing portions of iron plate at its lower part, be occupied by water, so as to rise an inch or more above the iron, and by superincumbent atmospheric air, so as to fill the remaining space, the volume of this air diminishes gradually, until at length about four-fifths of the original quantity alone remain. This residual gas extinguishes the flame of a candle, is incapable of

* The iron is covered with muslin, in order that the moisture may be retained on its surface, and that the slightest degree of oxidation may be made more apparent by the tinge imparted to it.

combustion, and possesses all the properties of nitrogen gas. The surface of the iron becomes completely oxidated,—If this experiment be made with pure oxygen, this gas is at length entirely absorbed.

If a glass jar, or a common vial, containing similar portions of bright iron plate, be filled with water deprived of its admixture of oxygen gas, and be sealed with mercury, or perfectly closed by a cork or glass stopper, the iron plates retain their lustre. But, if the jar be raised above the surface of the mercury, or if the cork or stopper be withdrawn, the portions of iron plate soon begin to tarnish and oxidate, those portions losing their lustre first which are placed nearest the external air. If the two experiments be made simultaneously, the contrast between the lustre of those portions of iron plate immersed in water excluded from the atmospheric air, and the oxidation of those plates which communicate with the external air by means of the water in which they are contained, is soon very remarkable. These experiments confirm the opinion, that water induces oxidation in iron, only in consequence of its admixture of oxygen gas absorbed from the atmospheric air.

VI. If the plates of iron be merely moistened, or covered with moistened muslin, or if the internal surface of a glass jar be lined with moistened iron filings, a similar but still more rapid absorption of oxygen gas, and a still more rapid oxidation of the iron, take place.

It appears unnecessary to detail any experiments expressly in proof of this observation. It will be sufficient to state some applications and illustrations of the general principle or fact just announced.

In the first place, this principle suggests to the practical chemist, an easy eudiometer. A glass jar moistened with water and sprinkled with iron filings, acts in a sufficiently rapid manner in absorbing the oxygen of the air contained in it, for many of the purposes of eudiometric chemistry. But as the oxide of iron formed may absorb any carbonic acid in the air subjected to the action of the moistened iron filings, this acid must be previously abstracted, if necessary, by one of the usual methods.

Secondly, The same apparatus affords also an easy method of obtaining nitrogen gas, by abstracting the oxygen from the atmospheric air.

Thirdly, Plates of iron covered with moistened muslin, constitute a most delicate test of the presence of oxygen gas.—A small vial, about one cubic inch and a half in capacity, was filled with atmospheric air, and a portion of iron plate covered with moistened muslin, was introduced into it. The muslin soon became discoloured, and assumed at first a reddish-brown, and at length a blackish colour; the vial, in the mean time, became occupied to about one-fifth by the mercury in which it was inverted. The vial was now lifted, for a moment, above the surface of the mercury, so as to admit sufficient atmospheric air to occupy the space left by the absorbed oxygen, and a second portion of iron plate, covered with moistened muslin, was introduced. The discoloration of the muslin was still considerable, a brownish-yellow colour being induced.—The effect was still very manifest on admitting the atmospheric air, and introducing a portion of iron covered with moistened muslin, a second and a third time, in the same manner as before, and when the proportion of oxygen in the cubic inch and a half of gas, was not even one two-hundred-and-fiftieth; and the effect would be greater still, if the volume of gas were more considerable.

VII. If the plates of iron covered with moistened muslin be secluded entirely from the contact of oxygen gas, the surface of the metal remains unoxidated, and the colour of the muslin unchanged.

Portions of iron plate covered with moistened muslin were introduced into vials containing respectively pure nitrogen, hydrogen, and carbonic acid gas, and pure water. They retained their whiteness perfectly unsullied for many months, and the gases suffered no change of bulk. There appears, therefore, to be no decomposition of the water, formerly supposed to occur when iron is moistened with this fluid.

VIII. If iron, either merely moistened, or deeply covered by water, be exposed to act on pure oxygen gas, this gas is progressively absorbed; but not with that rapidity which might, *a priori*, have been expected.

The statement of this experiment affords the writer an opportunity of alluding to the great and singular difference between the slow and rapid union of oxygen, with respect to the influence of the greater or less degree of purity of this gas on the rapidity and energy of the action. Combustion, or the rapid combination of oxygen, is much more violent in pure oxygen gas, than in oxygen gas diluted as in atmospheric air. But the difference in the degree of celerity, of the slow combination or absorption of oxygen, in pure or diluted oxygen gas, is by no means so considerable.

IX. Very damp air oxidates iron with great rapidity. Perfectly dry air, or dry oxygen gas, on the contrary, remains unabsorbed, and the iron exposed to it unchanged in its lustre.

These facts are matter of general observation. Iron cutlery retains its polish in dry weather: but soon becomes obscured by rusting, if exposed to the action of damp air. The surface of a bright or polished piece of iron remains untarnished in a dry room and atmosphere, but soon rusts if exposed to air surcharged with moisture by the formation of aqueous vapour.—A stratum of water is probably first deposited from the damp air on the surface of the metal, so that the experiment is reduced to the case of moistened iron. Iron is thus a eudiometer when moistened, or placed in damp air; but it is incapable of uniting with oxygen without the co-operative energy of water.

X. It has been stated by different chemists *, that moistened iron filings placed in nitrogen gas or atmospheric air, occasion the formation of ammonia, the water being decomposed, and the nascent hydrogen combining with the nitrogen. I conclude this statement to be incorrect from the following considerations:—

First, the decomposition of the water by the contact of iron, and the formation of nascent hydrogen, presupposed as the cause of the formation of ammonia, have been shown not to take place.

Secondly, a plate of iron covered with moistened muslin, and exposed to the action of nitrogen gas, does not undergo the slightest discoloration.

* Annales de Chimie, Tome II. p. 260., &c.

Thirdly, moistened iron filings placed in pure nitrogen gas, do not suffer any oxidation, or induce the slightest diminution in the volume of the gas.

Fourthly, in the numerous experiments detailed, in which nitrogen gas was placed in contact with moistened iron filings, no perceptible trace of ammonia could be discovered.

Fifthly, moistened iron filings, exposed for many days to the operation of atmospheric air, over the extensive surface of a retort containing twelve pints, afforded not a trace of ammonia on distillation.

Lastly, the tests of ammonia, employed by the author of this opinion, appear insufficient and fallacious. The vegetable colours, at least, are somewhat changed by the contact of spring water alone.

XI. The experiment, in which iron perfectly immersed in water absorbs the superincumbent oxygen, may perhaps be aptly compared to the function of respiration in fishes; whilst the experiment with moistened iron may be compared to the respiration of animals which inhabit the surface of the globe and breathe the atmospheric air. And it has been stated that the dilution of the oxygen gas by means of the nitrogen gas of the atmosphere, does not materially impede the slow combination of that gas, of which respiration presents us with one example; whilst this dilution answers the purpose of restraining what would otherwise be an undue activity in the rapid eombination of oxygen, or combustion: thus is our atmosphere calculated, in a double sense, to effect the wise purposes apparently intended by its Creator.

XII. From the preceding statements, it is hoped that the double chemical relation of air and water, in the liquid and gaseous forms, may have received an illustration not attempted by any former experimenter; and that a ray of light may have been thrown on the nature of that union of absorbed air and water in the liquid state, which, whether chemical or mechanical, renders the former susceptible of combinations of which it was incapable whilst it retained the gaseous form and was deprived of moisture.

XIII. These experiments may also suggest an investigation of he mutual action of water, and some other of the gases, as sul-

phuretted hydrogen, and the substances with which they combine respectively; and of the mutual action of air and water, and other metals, besides iron.

XIV. In pursuing these experiments, the greatest assistance has been derived from an instrument, which they indeed suggested, for making the necessary corrections, in pneumatic experiments, for reducing the volumes of the gases to a given standard. This instrument, designated the Aërometer, is described in the ninth number of this Journal.

Art. VIII. *Letter from a Gentleman proceeding on a Public Mission into Tartary.*

July 18.

To enable me the better to comply with your request, I shall adopt the form of a journal, taking up my pen from time to time, as often as any thing new may occur. To avoid the necessity of repetition, I shall commence with a general description of the nature of the road. All passes through the *Himálaya* in this direction are formed by rivers. Accordingly the *Nítí Ghat* lies along the banks of the *Daulí* river, which, in point of size, may be considered as the principal branch of the Ganges. The mountains on either side are, generally speaking, composed of rock, scarped perpendicularly; and it is from the projection of these scarped rocks into the river, that the difficulties and dangers of the pass arise. Where a bridge and a road on the opposite side are practicable, the difficulty is avoided by crossing the river. In some cases the projection is passed on wooden scaffoldings, supported either on crags of the rock, or on short rafters driven horizontally into the fissures. Where no facilities for the above plans exist, it becomes necessary to climb over the opposing mountain; and the danger and difficulty are in such case proportioned to the height and steepness of the ascent. The part of the road, so particularly mentioned by Moorcraft* on account of the danger,

* As. Res. xii.

is of this description. The bridges having been since repaired, I avoided the place by crossing the river. In order to give you a clearer idea, it need only be said, that the old road at the point in question forms, as nearly as possible, the two sides of an isosceles triangle; each of which is probably near a mile; while the base cannot exceed two hundred and fifty to three hundred yards; and such is the steepness, that, from the opposite bank of the river which is there about ninety feet wide, I could follow the road up the mountain and down again the whole way with my eye. As different names of bridges will occasionally occur in this account, I have, to save the necessity of description, drawn a rough sketch of one of each kind. I am, as you know, no draftsman: the drawing is, however, without any pretensions to perspective, sufficiently accurate to give an idea of what is meant to be represented.

On the 25th June I left *Jóshímath*, and proceeded on that and the two following days to *Tapóban*, *Lata*, and *Jelam*, respectively. The road up to this latter place is certainly the worst part of the whole pass. It is, however, by no means formidable; and is, generally speaking, better than many paths which I have travelled in the hills. During the last wet day I rode a *yak* or *chaunr** during some of the march. This animal is extremely sure-footed and strong; and, could he endure heat, would in the hills be a preferable mode of carriage to a horse. At the village of *Jelam* the country of *Bhote* may be said to commence: as at the villages below that, the inhabitants are able to continue in their houses throughout the year. From *Jelam* upwards all access and passage is prevented by the snow, from the month of October to May, and during that period the *Bhotiyah* villages remain wholly deserted. At this point a visible alteration was observable, both in the produce and progress of vegetation. Spring had here just commenced, and the productions of the lower parts were replaced by cypress, hazel, and birch trees; the bushes, consisting chiefly of gooseberry, currant, a dwarf species of cypress and *bidhara*, (juniper?) and dog-roses, red and white, differing from

* Tartarian ox. Bos grunniens. *Pall.*

those below. The only grains which ripen north of *Lata* are *Papera**, (peculiar to *Bhote*) *China*†, *Awa*‡, and *Jau*§: the two latter, both species of barley. The birds and quadrupeds found in *Bhote* are almost all peculiar to that part of the country: they consist of musk-deer‖, chamois¶, brown marmots**, *Bharals*††, remarkable for the extraordinary size of their horns: (the animal itself is about the height of an antelope, but much stouter in make; its colour dark grey, with black and white points, and wire-haired: its coat is, however, excessively thick, and is in consequence much prized): lastly, bears, some black‡‡, but most commonly white§§: these latter are represented to be carnivorous, frequently carrying off the sheep and goats while feeding in the jungles. The birds are blue pheasants‖‖, ptarmigans¶¶, black and white pigeons, rooks with bright red legs, hawks, falcons, and eagles. There are also a few varieties of small birds. The insects are very few; and I scarcely have seen a single fly since my arrival at *Jelam*; a circumstance the more striking from the contrast which the lower parts of the Ghat present: the flies being there so numerous and troublesome, as to render it impossible to walk, eat, or sleep, with any comfort.

Having given you this brief view of the general productions of *Bhote*, I shall now proceed on my journey. From *Jelam* I marched successively to *Malári* and *Gàmsáli*, the road as usual lying along the banks of the *Dauli* river. It was every where remarkably good, and the whole distance was performed on a

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* Mentioned by Mr. Moorcroft, under the name of *Phapher*, as resembling French wheat.

† Panicum miliaceum.

‡ Hordeum, a new species?

§ Hordeum hexastichon.

‖ Moschus Moschiferus.

¶ Antelope rupicapra? Perhaps a new species.

** Arctomys Bobac?

†† Ovis Ammon?

‡‡ Ursus Indicus. Black, with a white spot on the chest.

§§ Ursus Arctos: the white variety.

‖‖ Phasianus impeyanus.

¶¶ Tetrao lagopus, or a kindred sort.

chaunr. Immediately on quitting *Málari,* the river is crossed by a *sauga,* or spar bridge, at the extremity of which is a high barrier formed by a strong wooden door, supported by a stone-wall. This was erected with a view of preventing the plundering incursions of the *Jewaur, Darma,* and other eastern *Bhotiyas,* which were frequent during the former governments.

At *Gámsáli* I met the *Vakíl,* who had just returned from *Dapa.* This character is at present filled by a *Bhotiya,* who, on the *Ghat* becoming practicable, proceeds to *Dapa* with a present, consisting of a few yards of cotton cloth, *&c.* In return he receives from the *Vizier* of *Dapa,* as an offering to the government of *Garhwál,* one *Phatang* of gold-dust. This custom originated in the conquest of *Dapa* and the adjacent country, by *Futteh Sah,* a former *Rajah* of *Srínagar.* This person, advancing with an army through the *Níti* Pass, exacted a tribute from the *Rajah* of *Dapa,* consisting annually of a gold *Taulia,* weighing 2½ *Sers,* and the cast of an image also formed in gold. This tribute continued to be paid until the conquest of *Garhwál* by the *Gorkhas.* At present the only remains which exist are the honorary dress of cloth carried by the *Vakíl* and the *Phatang* of gold which he receives.

After the return of this *Vakíl* the communication to Tartary is considered as open; and the *Bhotiyas* are then at liberty to proceed thither with their merchandise. On the present occasion the *Vakíl* reported that the grass was not yet sufficiently grown in the *Ghat* to afford pasture for the sheep. The *Bhotiyas* in consequence informed me, that they should delay their departure for ten or twelve days. This report of the *Vakíl,* and the delay resulting from it, were, I have reason to believe, both prescribed by the *Dapa* government, who wished to gain time for deliberating on the mode of my reception at the frontier. The determination of the *Bhotiyas* was, however, perfectly conformable to my wishes; as a small investment expected from Calcutta had not yet arrived.

This halt enables me to say something regarding the *Bhotiya* villages and their inhabitants. As the spots adapted for cultivation are few, the villages are necessarily thinly scattered; their size also in this *Ghat* is far from great; *Malari,* the largest, not

containing above forty houses. These are generally from two to four stories high, built of stone, with pitched roofs formed of earth beat down on boards, with a layer of *Bhojpatr** between. To this latter material the roof chiefly owes its capacity for keeping out water; as when the *Bhojpatr* is omitted or becomes rotten, leaks invariably take place.

The *Bhotiyas*, those at least who have a real title to that appellation, are certainly of Tartar origin; and such is their own opinion. Indeed, so comparatively recent is the emigration of the inhabitants of *Níti*, that they enjoy at the present moment, on the ground of their being Tartars, an immunity from all duties paid by other traders, to the Tartar government. In language and personal appearance there is a striking affinity; and, though they no longer intermarry, yet the *Bhotiyas* do not hesitate to eat and drink with the Tartars. The religion is generally the same, except that the *Bhotiyas* have adopted some of the *Hindu* superstitions. They still, however, entertain great veneration for the Lamas. Until the *Gorkha* government, numbers of bulls and oxen were annually sacrificed in *Bhote*. This practice was then prohibited; and buffaloes and *chawnrs* directed to be substituted; and this substitution yet continues. The *Bhotiyas* are, however, still considered as cow-killers by the other inhabitants of the hills, and as such are outcasts in every respect.

Great quantities of ardent spirits, made from rice, are consumed here; and the use is in some measure rendered necessary by the coldness of the climate.

It remains now to say something of the temperature. This, from observations made with a Fahrenheit thermometer, varies in the shade during the hottest part of the day from 60° to 75°; and at day-light and night, from 45° to 50°. The days are generally fine, and the sun visible nearly throughout his course. The quantity of rain which falls at this season is small; during the fortnight I have been in *Bhote*, only four showers have occurred, all slight and of short continuance; during the same period, as I learn from Captain Webb, it has been pouring in-

* Bark of birch.

cessantly in the hills below. After the middle of August, the weather becomes very precarious. From that period none of the inhabitants are suffered to ascend to the tops of the surrounding mountains, or to use fire-arms in the neighbourhood of the villages; as the occurrence of either of these events at that time is found from experience, generally to produce a fall of snow above, and a frost below*; by which latter the ripening crops are wholly destroyed. My camp is now at *Niti*, from which place I expect to move north in seven or eight days. The result of my further progress will be detailed in my next.

G. W. T.

Art. IX. *Some Observations on the Sea Serpent. By* W. D. Peck, A.M., F.A.A., *Professor of Natural History in Harvard College. From the American Philosophical Transactions.*

The appearance in this vicinity the last summer of an enormous animal of the serpentine order, is a fact so remarkable here, and so interesting to naturalists every where, that the Academy at their last meeting, were of opinion that some notice of it should appear in their next publication, and appointed me to consider the evidence of the fact. I beg leave to offer the following as the result of my inquiries.

The writers on natural history for more than 2,000 years have mentioned Sea-Serpents. It may not be entirely foreign to the purpose to notice what they have left us on this obscure subject. Aristotle, the father of Zoölogy, observes in Lib. II. Chap. XIV. "that there are serpents in the sea as well as on the land, and in fresh waters. That some of those in the sea, in form resemble

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* If this be not a mere vulgar error, may it not be founded upon familiar observation, when the temperature of the atmosphere is at the freezing point, or even below that point, in perfect calm; and any the least concussion of the air may then produce instantaneous congelation of suspended vapour; in like manner, as water cooled below the temperature of melting snow, without ceasing to be liquid, is congealed with the slightest motion? C.

those of the land, except that the head has a greater resemblance to the conger."

His ὄφις θαλάττιος, Lib. IX. Chap. 17, was probably the conger or some other species of Muræna. The Muræna colubrina found in Amboina, M. Ophis, Serpens and Myrus, in Europe; and Mur. Echidna in the Pacific Ocean, resemble serpents in their form, but are furnished with fins.

The ὕδρος and χέρσυδρος of Ælian, the Hydrus and Chersydrus of Pliny, may both be referred to Coluber Natrix of Linnæus, which frequents fresh waters, and very much resembles our own water adder, which is found in similar situations. The notion of the enormous serpents brought by Virgil from Tenedos, was probably suggested to the Greek poets, from whom he took the hint, by the appearance and habits of the same Coluber Natrix, enlarged and made more terrible by poetic fancy.

The story mentioned by Pliny, Lib. VIII, Chap. 14, of an enormous river serpent in Africa, was probably a fiction or great exaggeration, and was more than two centuries old when he copied it from Livy or Valerius Maximus.

It does not appear from any thing in the writings of the ancient naturalists, that what is now called Sea-Serpent, was known in their times. It is of modern discovery, and was, I believe, first mentioned by Olaus Magnus, in his Historia de Gentibus Septentrionalibus. He seems to have been as credulous as Pliny, and the figure which he gives of this serpent, as well as of other marine animals, was probably sketched from the extravagant relations of sea-faring people.

He represents the serpent he speaks of, as several hundred feet in length, and in the act of taking sailors from the deck of a ship. The work of Magnus was published at Rome in 1555. In 1558 Gesner published the IVth book of his History of Animals. In this he copies the figure of Magnus with a short description, as he found it, without comment. Ruysh, in his Theatrum Animalium, published in 1718, copies the figure of Magnus, omitting the ship.

Finally, the Rt. Rev. Eric Pontoppidan, bishop of Bergen, in his Natural History of Norway, published in 1752 and 1753,

gives, on the authority of a naval officer in the Danish service, a more rational and credible account of it. The figure which he gives seems to have been made from the description of Captain De Ferry, the officer above alluded to. In this figure, the head and jugular region are raised out of the water; a little below the head is a mane which seems to be inserted all round the back part of the neck. The appearance of this mane was most probably an optical deception, and was nothing more than the water displaced by the neck, in the progress of the animal through it, returning to its level. It had probably no mane. But of the existence of the animal, the testimony* presented by the Rev. Bishop is sufficiently conclusive.

The testimony is ample of the existence of such a serpent, in the portion of the Atlantic which washes our shores.

It appears by papers sent to the Academy in the year 1810, that this serpent was first seen in Penobscot Bay about the year 1779, by Mr. Stephen Tuckey: he compared it to an unwrought spar (meaning probably one of spruce) which the scaly surface and dark colour of the animal would very much resemble; he thought it fifty or sixty feet in length.

The next notice is from Captain Eleazar Crabtree, who saw it in the same bay about the year 1785; he estimated its length at sixty feet, and its diameter he thought equal to that of a barrel, which is about twenty-two inches.

In the publication of the Linnæan Society, to whose committee we are indebted for collecting the most recent testimonies on this subject, is a letter from the Rev. Mr. Jenks of Bath, who states that in conversation with the Rev. Mr. Cummings†, the latter gentleman observed, that "this animal had been seen occasionally in Penobscot Bay within thirty years; supposed to be

* A letter of Captain De Ferry, and the declaration on oath of two of his crew who were with him when he saw and shot at it.

† A letter from this gentleman was forwarded to the Academy about the year 1806, giving a particular account of the animal, as he saw it, at a small distance; but this letter is lost or mislaid, as are the testimony, on oath, of Captain Crabtree, and a letter from the late Captain George Little.

above sixty feet in length, and of the size of a sloop's mast. That it had been seen by the inhabitants of Fox and Long Islands, and one of them, a Mr. Crocket, had seen two of them together about the year 1787."

These are the earliest notices I can find of this animal on our shores; and their truth is rendered indubitable by the evidence lately brought together by the committee of the Linnæan Society, of men of fair and unblemished character in Gloucester; of Captain Toppan and two of his people, of the schooner Laura of Portsmouth, and Captain Elkanah Finney of Plymouth.

The account of it by Lonson Nash, esq., justice of the peace in Gloucester, from his own observation, is perfectly free from prejudice, and as clear and satisfactory as can be expected of an object at the distance of two hundred and fifty yards.

Mr. Nash saw it with a perspective glass, whose field of view at that distance he found about forty-five feet in diameter, and the length of the visible part of the animal was greater than could be included in that field of view.

I do not perceive by the accounts that any person has seen its whole length. Mr. Nash estimates it at seventy feet at least, and thinks it may be even an hundred, and its diameter equal to that of a half-barrel, about sixteen or seventeen inches. Its colour appeared to him very dark, almost black. It moved by vertical undulations of the body, and with great velocity, *i. e.*, at the rate of a mile in four minutes.

In addition to Mr. Nash's account, eight persons, citizens of Gloucester*, Captain Toppan and two of his people, on their voyage to Boston, have furnished their testimony on oath, of the presence of this animal in the harbour of Gloucester and its vicinity, from the 10th to the 28th inclusive, of August last, and it appears by the affidavit of Captain Finney, that it was seen by him in June 1815, in a cove on the Plymouth shore.

The accounts of all these persons are very consistent; to the greater part it appeared to be straight, or without gibbosities or

* Messrs. Story, Allen, Ellery, Foster, Gaffney, Mansfield, Johnson, and Pearson.

protuberances on the back; one person thought it had protuberances, but it seems probable that the upper flexures of its undulations occasioned this opinion.

Its velocity is variously estimated; by some it was thought to move a mile in one minute, by others in three, four, or five minutes. It has great lateral flexibility, as is shewn by its turning short and moving in an exactly contrary direction, advancing the head in a line parallel with the body; hence its undulations, when under water and equally surrounded by the medium, may be either vertical or horizontal at the will of the animal. The judgment of its velocity, however, without knowing its precise distance, and without instruments to observe it, is extremely liable to err.

In the testimonies above referred to, the imagination seems to have had no influence, and we certainly know from them, that the existence of the animal to which they relate is indisputable; we know that it moves by vertical undulations, at least while near the surface of the sea; that it is laterally as flexible as other serpents; and that its motion, at times, is very swift; but our knowledge is circumscribed by these limits. It is to be hoped, that if it again visits our shores, some successful means may be devised of taking it, and presenting an opportunity of completing our knowledge of so interesting a link in the chain of animated beings.

It has been seen in Long Island Sound, progressing southward; it seems from this circumstance to be migratory, like the Coluber Natrix in Hungary, and may pass the winter season in Mexico or South America.

ART. X. *An Account of the Esquimaux, who inhabit the West Coast of Greenland, above the latitude 76°; in a Letter to the Editor from* Captain Edward Sabine, *of the Royal Artillery,* F.R.S. *and* F.L.S.

Portland Place, March 1, 1819.

DEAR SIR,

I have much pleasure in complying with your request, in furnishing you with an account of the Esquimaux, who were dis-

covered in the late voyage to the north-west; and I am free to do so, having been induced by circumstances, which it is unnecessary here to enter on, to give up the design which I had announced on my return, of a separate publication; I look forward to the far more extensive opportunities which I trust the next voyage will afford, to enable me to collect much better information than I at present possess for such purpose, should I then see occasion to resume my intention.

These Esquimaux inhabit a strip of the west coast of Greenland, between the parallels of 76° and 77°. Their principal winter residence is a few miles to the north of Cape Dudley Diggs which will be found in almost any of the maps in which the outline of Baffin's Bay is preserved; from this point they spread for 30 or 40 miles each way along the shore during the summer months, for the purpose of fishing; we saw only the extreme stragglers to the southward, who were in the large and open Bay facing the south, which is formed by a change in the direction of the coast in latitude 76°. We are indebted for the greater part of what we know concerning them to our valuable and most useful interpreter, John Zaccheus; without him we should not have suspected, nor could we have been assured as we are, that although they are genuine Esquimaux, scarcely distinguishable by any external difference in appearance or deportment from the natives of the coast to the southward, yet so long a time has elapsed since they have been settled where they are, and so entirely have they been insulated from all communication, that we found them ignorant, even by tradition, that there were other people in the world than themselves, or other places than the spot they occupied; and we should have wholly lost the high gratification we received in being spectators of the impression which a world opening to their view produced on minds so unprepared. As may be well supposed, their first emotions were those of fear. The appearance of the ships terrified them exceedingly, in the supposition that they were supernatural; that they were animals sent from the sun or moon to destroy them; (these planets are in the Esquimaux' belief the abode of spirits, whose interference is much oftener deprecated than courted.) They came down on the ice on the evening when

they were first seen, on the eighth of August, to the distance of about a mile from the spot where the ships were anchored, and set up a general shout, as we learnt afterwards, to frighten the animals away; but when they heard the return of what we supposed was designed as hailing, they wheeled their sledges about, and drove off with increased alarm to their habitations on the shore, several miles distant. It was in vain that we put up a flag, and left presents on the ice, and sailed to a distance. We should never have induced them to come near us had not Zaccheus, with much boldness, ventured himself amongst them, and addressed them in their own language.

I propose to give a short account of our interviews, and a detail of the information we obtained. I took much pains to gain this information correctly. Zaccheus spoke English, but imperfectly; and instances were not uncommon, during the voyage, when it became evident that his meaning had been greatly misunderstood. I was therefore careful to avoid what are termed leading questions, and to let him always relate his story himself, writing it down, and laying it by for the time, and after an interval of some days putting him on the subject afresh, and again writing down what he said, and comparing the two accounts. I believe therefore what is stated on his authority is correct, so far as his authority goes.

We saw nothing of them on the ninth, but on the tenth several sledges were observed to come off from the shore, to some large icebergs about three or four miles from the ships, then anchored to the edge of the ice. The people who came in them got out at the foot, and ascended to the top of one of the icebergs, where they remained gazing at us. On observing them, Zaccheus was sent from the ship carrying a white flag, and some presents; he advanced to a lane of water as it is termed, at some little distance from them, which, as it fortunately happened, was just too wide to be passed, and therefore gave both parties confidence. He set up his flag, and called to them in Esquimaux to come to him, as he had some things to give them. After a time, four of the people on the icebergs were observed to quit them, and, with much hesitation and frequent stoppings by the way, to approach.

When they were near enough to converse, Zaccheus threw them a shirt, telling them that it was to keep them warm. The foremost, who was the oldest, had a knife in his hand, with which he seemed disposed to stand on his defence, asking if we were come to kill them. Zaccheus told them that we were good people, and were come to do them service, and give them clothes, and thus drew them by degrees into conversation, but it was some time before he could persuade them to touch the shirt *. When this difficulty was overcome, their fears gradually subsided; they accepted some beads and a looking-glass, which was handed from one to another, and excited great laughter. They asked many questions about the ships, as whether they could fly as well as swim; where they came from; and, when they heard that they were houses full of men, they inquired what they were made of, and whether the sails were wings. Zaccheus invited them to come on board, which they agreed to do, if they could get across the lane of water, for which purpose he returned to the ships for a plank. On their coming up, a scene ensued which is beyond description; their astonishment was unbounded, and their expression of it extravagant, uncouth, and ludicrous in the extreme; by the most extraordinary gestures, exclamations at every thing they saw, and the most immoderate laughter. Their common exclamation was *hi yaw, hi yaw*, the last syllable very broadly pronounced and dwelt upon; reminding some of our gentlemen who had been with Lord Amherst, of the Chinese expression. The ice anchors, cables, boats, in short every thing which they saw, each in its turn, excited in the highest degree the rudest wonder that can be imagined. They were prevailed on to ascend the ships' side from the ice. The attention of the first man who got up was at once rivetted to a spare top mast which was on the

* Many instances are related in old voyages of the refusal of the Esquimaux, on first meeting with Europeans, to touch any thing, lest it should kill them. This soon wears off; but a similar superstition that they shall die if they swallow any thing, is not so easily removed. We could never prevail on them to do more than put biscuit, for instance, in their mouth; they would wait until they were not observed, and then throw it away.

gang-way. He seemed unable to credit the evidence of his senses, or the assurance that it was wood. He examined it round and round, and asked again and again what it was. They were not very expert at climbing, and just as the second man had succeeded with some assistance in getting up, he took an alarm at a pig which he saw on the deck, and made his way back on the ice with great expedition. A third was attracted by the armourer's anvil, which he attempted to take up and run away with, but finding it too heavy to be lifted, he snatched up the hammer, leapt off the ship's side, and made off; but, upon being followed, dropt it, and was afraid to return.

They were extremely diverted on seeing a man go up to the mast-head, and on looking down the main-hatchway as they passed along the deck. They were taken into the cabin, and shewn various things to excite their surprise or interest. A concave mirror, which I had brought with me for such a purpose as the present, produced, we thought, the most effect in amusing them. They had no notion that there could be any language but their own, and persevered in talking to each of us through the day. On the whole, this interview was very entertaining, but not very useful to either party, beyond an introduction; they were in such an extreme state of astonishment as to be little capable of discrimination, and though it was attempted to question them, we could not confine their attention sufficiently to depend on their answers. They soon became impatient to get away, complaining of the heat of the cabin, and promising to return. They were given knives, clothes, looking-glasses, rings, and some other trifling presents, and left us their own knives and spears in exchange. One of the men, on receiving a string of beads, desired Zaccheus to say that he was much obliged, and would carry it home to his daughter. It was curious to notice, that a fondness for decoration was even here a characteristic of the female sex.

We had removed, by the 13th of August, to a few miles higher up the coast, where we had a much more interesting visit from a father and his son, the latter a boy about twelve years old. The news had spread along the shore, that the ships were very pretty houses, and contained good people, who gave away wood and

iron; accordingly, this man was tolerably at his ease even from the first, and examined whatever was shewn him with attention and inquiry. It was the general remark, that the quantity and size of the wood he saw about him dwelt principally on his thoughts; he was continually rubbing and feeling the tables and sides of the cabin, and indeed every piece of wood that came in his way. We learnt the largest shrubs that grew on shore had not stems of greater thickness than a finger. It is not surprising, therefore, that he could scarcely believe that the mast, which he put his arms round, to shew his astonishment at its size, was wood also. Zaccheus' canoe occupied him a long time; he amused himself in the cabin, whilst we were questioning him, by looking over the contents of a table-drawer, containing stationary; he examined each article in its turn, but a bundle of quills, with blue paper at the end, as they are made up in shops, struck his fancy as the greatest curiosity. In replacing the drawer, he tried at first with the wrong end foremost, but corrected the mistake himself, which pleased him, and he returned to it frequently afterwards. He was shewn the pictures of the N. W. Indians in Vancouver's voyage, but he looked at them with comparative indifference. One of the gentlemen had got a conjuring toy, which appears to bore the nose, and make a hole for a string to be drawn through; but the exhibition of this trick had nearly been attended by consequences which would have been the reverse of the intention; he looked very grave, and upon some one pointing to the gentleman, and saying *angekok*, (or conjuror,) he got up with great expedition, followed by his son, and was making out of the cabin in alarm; when Zaccheus brought him back, by assuring him that we had no *angekok* amongst us, and by endeavouring to explain the trick. His attention was soon engaged afresh; but it was observed that he was never thoroughly reconciled to the gentleman, edged away from him continually, and shewed symptoms of considerable distrust in receiving presents from him. We could not notice in this man the slightest disposition to take away any thing that was not given him; he asked for any thing that pleased him, and it was satisfactory to observe, that it was generally for things which could be useful. When his requests were acceded to, his gratitude and the delight he expressed at his good fortune, were very

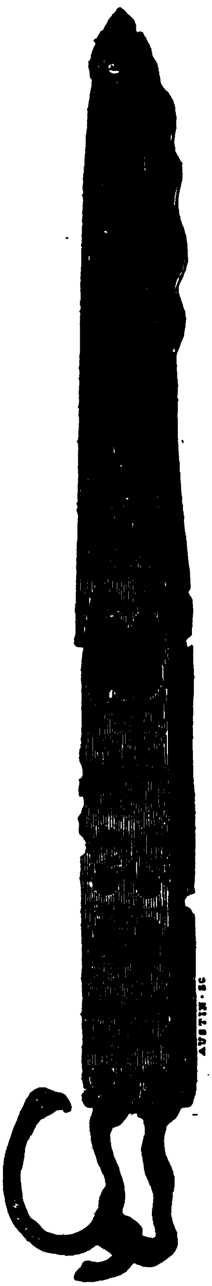
pleasing traits. He shewed a consideration for his wife, which is not customary amongst savages, in saying he should carry such and such things home to her; needles, for instance, and thread, of which he received a good stock, and asked permission to bring her to see the ships. One of our former visitors having inquired if the windows were ice, the Esquimaux name for it, *Sicou*, was mentioned to him whilst he was examining a tumbler; he understood immediately what was meant: and holding it between his hands, shewed us that they were not wet, and made signs that he would give it to his wife to drink out of. He parted from us loaded with presents, which he collected together, and tied with a string in a knot, which sailors call a common bend.

A bargain was made with him for a sledge and dog, for which he received a small spar, and the gunnel-streak, and one of the thwarts of a boat which had been squeezed by the ice.

Zaccheus accompanied him a part of the way home; he was very grateful for his reception, and wished Zaccheus to go on with him, that he might send back a present of skins. The height of the cabin had struck him, in comparison with their miserable huts; he said he had always lived in a low house, with a low door, but that he would alter it, and that if we came again we should find he had done so. It was pleasing to be convinced that, even amongst these poor people, who have lived in so wretched a manner for generations, there are individuals who are not insensible to the comparison of comfort, or to a desire of improving by example.

This man had four children, the boy was subject to the violent bleedings of the nose, which are common in Greenland.

On the following day we were visited by nine men, four of whom were the same we first saw, and who having profited by our liberality, had come off to see what more they could get; the man who had attempted to take away the hammer was amongst them, and looked very conscious when reminded of it. It was plain that they knew stealing was wrong, but equally so that they practised it, and were no mean proficients. Two of them proposed to entertain us with a song, for the purpose, as we found, of giving the others the opportunity of pilfering, which they did with such adroitness that they were not perceived until some things which they had taken were missed, and led to an examination, when various articles were



found concealed under their clothes. Amongst them was a very large telescope belonging to Captain Ross, which we could hardly believe had been secreted in our presence, and which would have been a very serious loss in the remaining part of the voyage. They were but little disconcerted at being detected, and we were soon glad to get rid of them. The song consisted of a repetition in regular time and cadence of the general chorus of the Esquimaux, *amnah*, *ayah*, *ayah*, &c., accompanied by many ridiculous gestures. They went away, promising to bring off some pieces of meteoric stone, for which they were promised a great reward. We did not quit the ice until the sixteenth of August, on which day the same party came off to the ships, but they were not admitted on board, and we saw no more of them.

Each of the Esquimaux who visited us on the tenth of August, and I believe each of the others whom we afterwards saw, had a rude instrument answering the purpose of a knife. The handle is of bone, from ten to twelve inches long, shaped like the handle of a clasped knife; in a groove, which is run along the edge, are inserted several bits of flattened iron, in number from three to seven in different knives, and occupying generally half the length. No contrivance was applied to fasten any of these pieces to the handle, except the one at the point, which was generally two-edged, and was rudely rivetted. In answer to our inquiries from whence they obtained

the iron, it was at first understood that they had found it on the shore; and it was supposed to be the hooping of casks, which might have been accidentally drifted on the land. We were surprised, however, in observing the facility with which they were induced to part with their knives; it is true, indeed, that they received far better instruments in exchange, but they did not appear to attach that value, which we should have expected, to iron so accidentally procured. This produced some discussion in the gun-room, when it appeared, that some of the officers who had been present in the cabin when the Esquimaux were questioned, were not satisfied that Zaccheus' interpretation had been rightly understood; he was accordingly sent for afresh, and told that it was desired to know what had been said about the iron of the knives (one of which was on the table,) and he was left to tell his story without interruption or help. He said it was not English or Danish, but Esquimaux iron; that it was got from two large stones on a hill near a part of the coast which we had lately passed, and which was now in sight; the stones were very hard; that small pieces were knocked off from them, and beat flat between other stones. He repeated this account two or three times, so that no doubt remained of his meaning. In reply to other questions, we gathered from him, that he had never heard of such stones in South Greenland; that the Esquimaux had said, they knew of no others but these two; that the iron breaks off from the stone just in the state we saw it, and was beat flat without being heated. Our subsequent visitors confirmed the above account, and added one curious circumstance, that the stones are not alike, one being altogether iron, and so hard and difficult to break, that their supply is obtained entirely from the other, which is composed principally of a hard and dark rock; and by breaking it, they get small pieces of iron out, which they beat as we see them. One of the men being asked to describe the size of each of the stones, made a motion with his hands, conveying the impression of a cube of two feet; and added, that it would go through the skylight of the cabin, which was rather larger. The hill is in about 76°. 10′ lat. and 64°¾′. long.; it is called by the natives *Sowilic*, derived from *sowic*, the name for iron amongst these people, as well as amongst the southern Greenlanders. Zaccheus told me, this word originally signified a

hard black stone, of which the Esquimaux made knives, before the Danes introduced iron amongst them, and that iron received the same name from being used for the same purpose. I suppose that the northern Esquimaux have applied it in a similar manner to the iron which they have thus accidentally found.

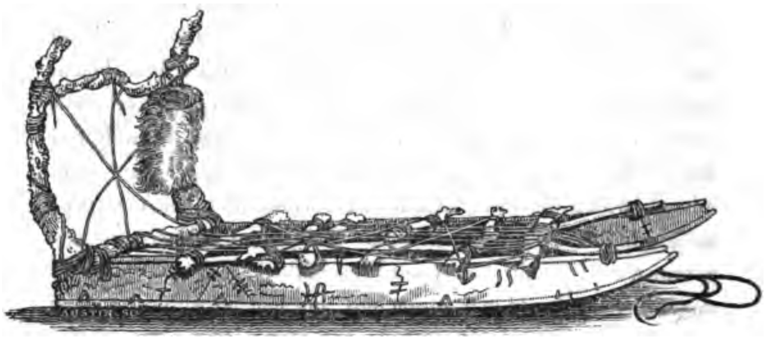
We are informed in the account of Captain Cook's third voyage, that the inhabitants of Norton Sound, which is in the immediate neighbourhood of Behring's Straits, call the iron which they procure from the Russians, *Shawic*, which is evidently the same word; the peculiar colour of these pieces of iron, their softness, and freedom from rust, strengthened the probability that they were of meteoric origin, which has since been proved by analysis *.

The height of the individuals whom we saw rather exceeded five feet on the average; their faces were broad, round, chubby, and flat, with high cheek-bones, and small eyes; their hair black, straight, and coarse; the young men had fine and even teeth, but we remarked that, in the older men, they were much worn down; and in some instances the front teeth of the upper jaw were missing, which we were told was in consequence of their custom of holding in their dogs by their teeth. The colour of their skin was a brown olive; their hands were small, thick, and well formed; they wore the beard and mustachios, but had no whiskers; their dress was exactly similar in fashion to the original dress of the South Greenlanders, described by Crantz, and is very well represented in the accompanying plate, from a drawing of Lieutenant Hoppner's (Plate 1.) The dress of the two sexes, as they told us, (for we saw no female), is very nearly the same; the fur is worn outwards, excepting in their boots. The skins which we saw in use were those of seals, dogs, foxes, and the cubs of bears.

The only weapons which we noticed in their possession were the knives, which have been already described, and a very rude spear, about five feet in length, made of pieces of bone, or of the horn of the sea unicorn. The pieces were not determinate in shape or number, nor were they fashioned in any way, but were merely tied together by strips of seals' skin, or by sinews. The

* See page 369, Vol. VI. of this Journal.

spears were usually pointed by a walrus' tooth, but, in one instance, the point was tipped with meteoric iron; a small piece of bone is attached to the middle, for the purpose of giving a firmer hold, and goes between the third and fourth finger when the spear is used; they sometimes fasten bladders of seals' skin to the spears, to prevent the animal which is struck from sinking. Their sledges are formed of pieces of bone, fastened together like the spears, and placed on runners of bone; these are sufficiently large to hold two persons, and are drawn by dogs, commonly from four to eight; each dog draws separately by a skin rope, which is fastened round its neck like a collar, and is attached to the sledge by a togle of bone at the other end.



They travel with great rapidity in a straight line, but have no reins, nor any other means of guiding or stopping the dogs, than by beating or speaking to them. They carry a spare pair of gloves and boots when they travel in their sledges, and appeared very carefully to avoid getting their feet wet. Their dogs were deep-chested and very powerful, all of the same breed, but differing in colour; black, white, yellow, and brindled. In the course of traffic we observed they gave a preference to the black ones.

We were greatly surprised to find them without canoes, or any means of going on the element from whence the greater part of their subsistence is derived. All the Esquimaux who were known before, and indeed all the inhabitants of the coast of North America, from Prince William's Sound, on the North-west, to the Labrador and Greenland coasts inclusive, with the exception of these people, have been found with

canoes of the same peculiar and very remarkable construction. We endeavoured to learn if they had any tradition that their ancestors had used them; but all that we could ascertain was, that their fathers could kill whales, which they cannot do now, but by what means they were unable to explain. Neither of the Esquimaux words for sorts of canoes, *kayak* or *umiak*, were known to them; nor did they seem to have an idea of a canoe, until they saw the one belonging to Zaccheus, which was on board the ship. It was unfortunate that the poor fellow had broken his collar-bone, and had his arm in consequence in a sling, which prevented him from shewing the dexterity with which he managed it, and the rapidity with which he could paddle; it would have been a gratification to him, and an interesting and useful sight to them. They examined it, however, with great curiosity on board, and seemed to enter very fully into its usefulness: this was remarked particularly in our intelligent visitor on the thirteenth, who asked many questions about the way in which it was made. He wished to buy it, and offered plenty of skins in exchange. We recommended him to set about making one, which he seemed disposed to attempt, but remarked that some part of the frame was made of wood, of which he had none. We told him that bone would do equally well, to which he assented.

I have little doubt that, if we visit them this year, we shall find that something of the kind has been tried. I wish they could have seen the canoe in the water, as it would have made a much deeper impression on them, and they would have been the more disposed to imitate it.

The fact of their having no canoes is a very extraordinary one; it is difficult to conceive that if they had known their value, and had ever possessed the art of making them, that it should have been lost: there is no deficiency of materials, they have as many skins as they can wish for, and although no wood, yet they have bone, which will answer nearly as well for the frame-work; at least the ingenuity of savage life would soon make it answer with accommodation: nor is their situation less favourable for the employment of canoes, than many other of the Esquimaux settlements; although so far to the North, the sea was much

freer from ice than we had found it for many degrees to the Southward; the shore especially was quite clear to the North of Cape Dudley Diggs, and they told us that it was always so in summer. Wolstenholm Sound, which, as Baffin says, contains many inlets and smaller sounds, must be a remarkably fine place for the fishery of seals and sea unicorns.

On the other hand, it seems very improbable that canoes were not known to their ancestors. In whatever manner, or by whatever route, the Esquimaux have spread along the shores of North America from their original in the West, they must undoubtedly have brought their canoes with them. The identity of those in use from one end of this extensive chain to the other, combined with their very ingenious and peculiar construction, puts this point beyond question; how curious, therefore, to have found an intermediate link without them.

Having no means of going on the water, their only mode of killing the seals and unicorns, or sea-horses, is by getting sufficiently near on the ice to strike them with the spear; this they accomplish by stratagems similar to those in general practice amongst the Esquimaux, but which they perform in great perfection. The process of luring seals is well known: the animals have holes in the ice through which they come out to bask on its surface; the Esquimaux places himself near the hole, and, as soon as a seal appears, he rolls himself on the ice, and imitates its motion and its cry; and, being moreover dressed in seals' skin, he succeeds in actually deceiving the animal, which, joining its supposed companion, meets its death. To excel in this mode of hunting is deemed a great accomplishment; accordingly Zaccheus was very eager in persuading them to go through the motions before him, and acknowledged that they performed even better than the South Greenlanders.

By such means they obtain an ample supply of the animals which constitute their principal food; they have beside the eggs and young of sea-fowl, which they take from their nests on the shore, and foxes which they entrap. When these resources fail during the winter, they have recourse to their dogs, but we could not learn that they made use of any vegetable production whatever.

They brought us several pieces of unicorns' flesh, in the dried state in which it is usually eaten, called *nicou*, both by them and by the South Greenlanders.

They lay by a store of provisions for the winter in holes under ground, as is the custom in the south. Their feasts are of the same description: several families are invited to partake of what they esteem their greatest luxury; it is a seal which has been kept in one of these underground repositories until it is a little beyond tender, when it is eaten without the addition of cooking of any sort. They prefer meat undressed, unless it is very fresh; this is general amongst Esquimaux. Zaccheus has often spoken to me with great animation of the sports and diversions which take place at these meetings, and by which they contrive to pass away their long winter very merrily. He fully confirmed all that Crantz says of the thorough good humour which prevails uninterruptedly. In spite of the absence of almost every thing which we consider to constitute enjoyment in life, the Esquimaux are a happy people; happy even in comparison with those who are far better off; and they are so, because they are generally good-tempered, and a disposition to quarrel or to injure another is very rare.

As we did not go on shore we did not visit their habitations, but they said that in summer they live under skins, and in winter in huts made partly under ground, and partly built up with stones and unicorns' horns. Zaccheus could learn no difference in their interior arrangements or customs, from those which prevail in the south, except that they keep their clothes on in the house. They obtain fire by friction, using bone instead of wood, and have no other fuel than the oil or blubber of seals; a large stone bowl being filled with oil, the surface is covered with a moss, the *Polytrichum juniperinum*, as a wick; these lamps give both light and heat.

The Esquimaux generally make the bowls of a particular kind of stone, which they name *okekesuk*, but these people call the material of theirs *ouyarak*, signifying stone of any kind; they did not know the other term. I gave one of them a piece of coal, and shewed him its use; he said there were no such stones in his country.

They reside in families; nor had we reason to believe that they differ in their social regulations in any respect from the general custom of the Esquimaux. The head of the family has control over the members, but is interfered with by no other authority.

The word *nullekab* was unknown to them. It has originated from the intercourse which the Danes have had with the South Greenlanders, and is applied to the individual who superintends any of the Danish settlements. Zaccheus asked them if they had a *nakouak* amongst them; (*i. e.*, one who can kill more seals than his neighbours, either by stratagem or strength, and is held in respect accordingly), but they did not understand him; he fortunately recollected that such persons were called *pisarsuak* in Greenland north of Disco; and upon mentioning this word they recognised it immediately, and said there was such a man, that he was then at their winter residence, and that his name was *Tolouak*, (or the Raven;) they said he was a very good man, but was getting old.

So far as we could learn, their superstitions are precisely similar to those described so fully by Crantz and Egede. *Torngarsuk* is the principal object of their religious veneration; they have the same mythological fable of the origin of the sun and moon, on which is founded Johnson's beautiful tale of Anningait and Ajut in the Rambler. The moon is still called *Anningak* amongst them, but this name has been nearly superseded in the south by *Kaimut*, through the endeavours of the Danish missionaries to get rid of all words which are connected with the original superstitions; it is sometimes called *Pinga* in the north.

They have also their *angekoks*, or persons who pretend to have intercourse with spirits, and to obtain power from them to heal diseases and to prophesy. The *angekoks* tell them that when they die they will go to the moon, where they will have wood in abundance. The first four men who came on board, and who had not got over the original impression that we had come from thence, noticed very particularly and significantly to each other when told that the ship was made of wood, "that there was plenty of wood in the moon." They add one to many preceding evidences, that man in a state of nature has still a belief that he shall live here-

after, although his expectations of future happiness are generally limited to a possession in abundance, of those things which he has most valued or most felt the want of in this life.

Their knowledge of the country is very limited; they are wholly unacquainted with the interior; it affords them no means of subsistence, and having no other mode of travelling than in sledges, their journeys are necessarily confined to the flat ice on the sea, in the neighbourhood of the shore. When this is melted in the summer their communications are impeded. Those whom we saw told us that they could not return to their winter residence until it should be dark; or, in other words, until the winter had set in and re-established their roads. Their knowledge of the country to the southward, is bounded by a range of mountains covered with snow, which ends abruptly in the sea, at the angle where the coast assumes a westerly direction, and is probably connected at the other extremity with the great central ridge which divides Greenland from north to south. These mountains they considered the limit of the habitable world to the south, supposing that all beyond was ice and snow. Towards the north, on the contrary, they told us the country was black land, that is, free from snow, and the water clear of ice during the summer as far as they were acquainted with it; this appeared to be about as much to the north of the place where they pass the winter, as they were now to the south of it, perhaps about seventy miles of coast. They could give us no idea of what number of people inhabited this district. Plenty! plenty! was all the information we could gain. They have no enemies, and, indeed, know of no other people than themselves. They could not tell whether the shore was inhabited beyond the farthest northern point of which they had personal knowledge. And as we did not pursue the close examination of the coast beyond Wolstenholm Sound, we had no means of determining. As well as we could judge from a great distance, the land answered the description which they had given of it. They had never seen land over the sea, and were unacquainted with the word *akilinuk*, by which the people of South Greenland call the opposite coast of Davis' Strait, which we learnt from a Danish superintendent of a settlement in Disco Bay, can be seen on a

very clear day on the horizon from the high land abreast of Women's Islands.

We were surprised to find them unacquainted with the Esquimaux name for reindeer, *tuktoo;* and, on further inquiry, there appeared reason to believe that the animal itself was unknown in this part of Greenland, as they did not recognise it by Zaccheus' description. They knew but of two large animals on the land, besides those which have been enumerated in the account of their food, namely, the *amarok* and the *umimuk*, but said that they had no means of killing either of them. The *amarok* has been known by name to writers on Greenland, but has not been yet described on the personal knowledge of any naturalist. Zaccheus said it is not uncommon about Jacob's-Bight and Disco-Bay, where its cry is frequently heard at night; but being a shy and very fierce animal, it is seldom killed by the natives. It resembles a cat, excepting in its size, which is about three times as large. Its skin is striped; it lives in holes in the rocks, and feeds on hares and grouse, which it lies in wait for, and catches by springing on them.

What the *umimuk* is, appears yet more doubtful. Fabricius, in the *Fauna Greenlandica*, p. 28, describes an animal under this name, the head and part of a carcase of which he had seen, having been found on a piece of ice in the Greenland sea. Believing that no such animal inhabited the western coast, he conceived that it had been drifted with the ice, either from East Greenland, or more probably from the northern coast of Asia. The skull was injured, and one of the horns broken off; but from the other, which was smooth and bent outwards, and from the hoofs and hair, the latter of which was long, black, and woolly, he considered it as identified with the *bos grunniens* of Linnéus. Whatever may have been the original animal, the name of *umimuk* has been since applied to the breed of cattle which the Danes introduced from Europe. It appears, however, that there actually is a large land animal (and horned, for so they describe it,) inhabiting Greenland, and called *umimuk* by Esquimaux who have never had communication with Danes. Whether it is the same which Fabricius saw may be doubted, but it seems very improbable that either should be the *bos grunniens*. Zaccheus repeated

to them the names of the various kind of fish which are caught on South Greenland, but they had never heard of them; and when desired to enumerate what they obtained from the sea, they mentioned only seals, sea-horses, unicorns, and whales. Captain Cook remarks, that in the Pacific, "the sea is destitute of small fish of every kind north of 60°, but whales become more numerous." Various kind of small fish, however, abound in the Greenland sea, to a much higher latitude than 60°, though probably not to 76°.

I was curious to learn in what manner they divided their time, as it will be recollected that in these high latitudes, nature makes no very marked distinction of days and hours, for a great part of the year, and but little at any period. I feared I should have had a difficulty in enabling Zaccheus to comprehend the nature of the inquiry; but in this, as in other similar instances, I did him an injustice. I found that his curiosity had been already excited to the same point; he had wished to ascertain from a party who were desirous to return to the ships, at what time we should expect them; but could get no other answer than, "soon," which appeared the nearest approach they could make to a definite term. They were not acquainted with the word, *Akaou*, by which the Southern Greenlanders express to-morrow; for Zaccheus remarked, they have no to-morrow; nor did they use the rise and fall of the tide as a division, which is common amongst Esquimaux. They appeared, as far as could be learnt, to make no distinction whatsoever; eating when they are hungry, sleeping when they are sleepy, and driving in their sledges on the ice till they or their dogs are tired. Such was the impression on Zaccheus' mind after questioning them; but it is probable they do make some division of time, though he was unable to discover it.

As it appeared an interesting point to ascertain to what amount their language differed from that spoken in the southern part of Greenland, I took much pains, both at the time and in frequent subsequent communications with Zaccheus, to obtain correct information. Crantz has remarked, that there is a difference in dialect and pronunciation between the Esquimaux of Labrador,

of South Greenland, and of the country north of Disco, to the Women's Islands. Zaccheus, who was a native of Disco Bay, spoke usually in the southern dialect; but was also acquainted with that of the Women's Islands, having learnt it when a child. He described the difference between the language of these people and of Women's Islands to be about as much as between the two dialects with which he was before acquainted, and to consist chiefly in the slow drawling pronunciation of the former, by which additional syllables are noticed in words which custom has abbreviated in the south. Some little difficulty of mutual understanding was observed in consequence at our first interview; but, short as our intercourse was with them, Zaccheus succeeded in adopting their manner of speaking so as to be perfectly understood. Indeed, I believe the difficulty at first was much augmented by the agitation of his feelings from delight at the discovery, which caused him to speak even quicker than usual. Notwithstanding the pains he took to recollect and inform me of such words as were not mutually understood, the few that my list contains are a curious indication how little change a language may undergo in a long course of years, when there is little or no foreign communication; and even amongst these few words, many are the expressions of new ideas, which may be traced to the intercourse of the Danes with the southern Esquimaux. The language does not appear to differ in construction from that spoken in the south. It has the same complicated inflections, and the same mode of declining by terminations. The numerals are the same.

I subjoin a few words which differ in the two dialects, and a few more which are the same, and which, being of most common occurrence, are sufficient to shew the identity of the language.

English.	*Northern.*	*Southern.*
Woman	Arneweset	Arnet.
Young man	Innugnowak	Innushotok
Harpoon	Oloetuk	Tookuk.
Harpoon shaft	Ippoa	Ermeinik.
Guillemot (a bird)	Pyeachusweet.	Akput.

English.	*Northern.*	*Southern.*
Duckskin shirt	Atee	Timiset.
Hood of the dress	Ilpaousuk ..	Okoutak.
Blackstone of the lamps	Okekesuk ..	Ouyarak(any stone)
Hook by which the lamp hangs,	Kelipsiut ..	Housut.
Auks (birds)	Akpalliarsuk,	Akpalliarshusweet.
Boiled Meat	Otelu......	Osotoclu.
Sledge	Kamoutic ..	Kamoutipalouit.
Traces for the dogs	Pittiutet....	Upiutet.

English.	*Esquimaux.*
Man,	Innuk.
Men,	Innuit.
Son,	Enra.
Daughter,	Pani.
Eyes,	Pisik.
Nose,	Kingak.
Mouth,	Kannek.
Skins,	Hammuk.
Sun,	Succanuk.
Fire,	Innek.
Seal,	Puisi.
Dog,	Kimuk.
Ice,	Sicou.
Sea-water	Himmok.
Fresh-water,	Himuk.
Sea-horse,	Havuk.
Whale,	Haphuk.
One,	Attausit.
Two,	Arlek.
Three,	Pingasut.
Four,	Sissimat.
Five,	Tellimat.

Amongst the various speculations which have been set forth of late, from which the probability of a N. W. passage has been inferred, it has surprised me that so little notice has been taken of the very remarkable fact, that the same people are found on the shores of Behring's Strait, and of those of Baffin's and Hudson's

Bays. Their persons, dress, mode of living, and language, (so far as the latter is known,) sufficiently prove the whole to be Esquimaux. The interior of a habitation at Norton Sound is an exact resemblance of a Greenlander's in all its disgusting peculiarities. Their singular customs are the same; they prefer their meat and fish raw, use lamps for fires, and have many other minor points of identity. But the most important one towards the argument for a passage has been already stated; namely, that their canoes and fishing apparatus attached to them are the same. It is remarked by Captain Cook that " enough is certain to warrant this judgment, that there is great reason to believe that these nations (*i. e.*, the inhabitants of the N. W. America and the Esquimaux) are of the same extraction; and if so, there can be little doubt of there being a northern communication of some sort by sea between this west side of America and the east side through Baffin's Bay." The Esquimaux are wholly and radically distinct and different from any of the Indians of the interior; they are occupiers of the coast alone; they never quit it, nor could they without undergoing a total change of habits and of life. There is, therefore, the strongest presumption that they must have made their way into Hudson's and Baffin's Bays by the sea-coast; in which case their route must have been either by the shores of a direct water communication, or by the northern and eastern coasts of Greenland, and round Cape Farewell; but there is good reason to believe that the latter was not their route, as the Danes were settled in West Greenland before the Esquimaux, of whom the first mention occurs, when they come in contact in their progress *south* in the fourteenth century with the most *northern* Danish colonies. The probability, therefore, is in favour of the first route, on which they have been found at intermediate points of the American coast, by Hearne and Mackenzie. This fact has always appeared to me one of the strongest presumptive proofs, that these gentlemen were really in the immediate neighbourhood of the sea.

May I trespass a little farther on your space, in answer to a question which is very often put to me, viz., What has the late voyage actually effected towards a N. W. passage? This may be fully answered without entering into much detail.

An important service has been rendered in establishing the credit which is due to the journals of our old navigators. So far as we pursued Baffin's track, we had continual reason to admire the faithfulness of his descriptions, and the general correctness of his observations; it may be presumed, therefore, that his account is equally to be relied on where he went beyond us, or approached the coast nearer than we did. His voyages, and those of Davis, have left but few portions of the coast unexplored; but those portions are the most interesting from situation and from circumstance. Although the general direction of the land had impressed Baffin's mind with a persuasion that it formed the Bay which has borne his name, yet it is plain, from his own account, that even *he* did not consider that he had proved it to be a bay. He had seen the land only at intervals, interrupted by large inlets or openings in the coast, to which he gave the name of sounds; and he felt it necessary to apologize for having sought the coast no better, and to explain the circumstances which had prevented him. It is partly on these inlets that the hopes of persons who have thought since then, on the probability of a passage, have been fixed. It has been expected that one or more will be found to communicate with the northern ocean. The instructions to Lieutenant Young, in 1777, directed him to examine these inlets, but he did not reach the coast. They have remained unexplored, and still remain so. There are altogether seven sounds, of which five only are interesting, from being on the northern and western coasts. Of these the first is Wolstenholm Sound, the entrance of which we passed at a few miles' distance, sufficiently near to identify it by "the island in the midst, which maketh two entrances." Of Whale Sound we could just discern the opening in the coast, being thirty or forty miles distant from us. Of Smith's Sound, "the greatest and longest in all this bay, and which runneth to the north of 78°," we can say nothing, as our extreme north was in 76° 53′. We were near the entrance of Jones's Sound, but not so near as Baffin, who sent his boat on shore; we had thick weather; the sound was full of ice, and not then accessible.

The last is Lancaster's Sound, which Baffin merely opened, but we sailed into for about thirty miles. It is needless to enter

into a detail* here of the many encouraging coincidences which awaited us in this, the only one of Baffin's sounds into which we entered; The great depth of water, the sudden increase in its temperature, the absence of ice, the direction of the swell, the width of the shores apart, (exceeding that of Behring's Straits,) and the different character of the country on the north and south sides, especially in the latter appearing to be wooded. This magnificent inlet will no doubt be fully explored by the expedition now fitting, and those who are so employed will have the privilege of being the first whose curiosity will be gratified, in following where it may lead, or in putting its termination, should there prove one, beyond a question †.

From Lancaster's Sound to the entrance of Cumberland Strait the coast was imperfectly known before, and was very imperfectly seen by us; from thence to Repulse Bay, a distance in a direct line of not less than between four and five hundred miles, nothing has been added since the voyages of Davis, Baffin, and of Foxe. The little that is known is favourable rather than otherwise, especially at the Welcome.

It may be, therefore, said that the last voyage has narrowed the ground of inquiry, by establishing the general truth of Baffin's narrative; and that there remains for the employment of the present expedition an examination of all those parts of the coast, which our old navigators have left uncertain, from the west side of Greenland to Repulse Bay.

Believe me, Dear Sir, most sincerely yours,

EDWARD SABINE.

* This has been already done in a letter from an officer of the Alexander, published in Blackwood's Edinburgh Magazine for December last; a well written, and what is more important, a faithful, account of the proceedings of the expedition. Having said thus much, I trust the writer will excuse my adding, that I do not agree with him in his remarks on Captain Flinders.

† It is worthy of notice, and has not been, I believe, remarked before, that the only one of Baffin's seven sounds which has been since examined, namely, the "fair sound in latitude 70° 20'," when he anchored for two days on his way up the Greenland Coast, proves to have been, in fact, the entrance of the Waigat Straits. So easy is it for the most experienced person to be mistaken, except upon a very close examination.

ART. XI. *Description of an Ore of Copper from Cornwall. By* William Phillips, F. L. S., *Member of the Geological Societies of London and Cornwall.*

AMONG the many ores of copper which have been raised from the Cornish mines, there is one which has received so little notice, that it has been mentioned only by one mineralogist, and, even in that instance, only with reference to one of its crystalline forms. It is termed by Sowerby, in his British Mineralogy (tab. 503, 'grey sulphuret of copper, in dodecahedral crystals.'—This mineral is by no means common, although it has been found in several mines. I possess about twenty specimens, which have enabled me to examine with attention its crystalline forms; some of which at least are not analogous to those of any other substance found in that of the rhomboidal dodecahedron; and it differs so greatly from all the other ores of copper, as to induce both my brother and myself long since to adopt the conclusion, that this mineral differs from those ores, not less in its chemical than in some of its external characters; and, therefore, that its apparent claim to the distinction of a new species ought to be investigated.

This mineral varies internally from lead-grey to iron-black. It rarely occurs massive, but is commonly crystallized in the form of the rhomboidal dodecahedron, either perfect, or variously modified; also, though rarely, in the form of the cube and octohedron, of which the edges and angles are replaced. Externally the crystals are often nearly of a tin-white colour, and very splendent; sometimes lead-grey, with but little lustre; occasionally iron-black and dull.

The fracture is imperfectly lamellar, and uneven, with the appearance (by reflection from surfaces produced by mechanical division) of natural joints, parallel to the planes of the rhomboidal dodecahedron; the lustre of the fragments varies from glistening to shining, and is metallic. Its specific gravity is 4.375.

It is harder than vitreous copper, (cuivre sulfuré, Haüy,) and the fahlerz (cuivre gris, Haüy,) which it readily scratches, and is brittle. Its powder is reddish-grey.

Before the blow-pipe on charcoal it first burns with a blue flame,

and slight decrepitation; to which succeed copious arsenical vapours, leaving a greyish-black scoria, which affects the magnetic needle.

I have observed twenty-seven varieties in the forms of the crystals of this substance; of these twelve are selected (plate II.) as affording a sufficient clue to the whole. The rhomboidal dodecahedron (fig. 1,) may be considered as the primary crystal; and all the twenty-seven varieties as arising from combinations of the planes, though extremely variable in shape, of four modifications, observable in figs. 2 to 7, which, except the small triangular planes of fig. 7, are all more or less common to several substances, assuming the form of the rhomboidal dodecahedron, the cube, or the regular octohedron.

The remaining five figures (8 to 12) require an observation or two. In these there is not that symmetry of form which might be expected to exist in the planes, modifying so perfect a geometrical figure as the rhomboidal dodecahedron. From the symmetrical manner in which these forms are usually delineated, we might expect that when one solid angle is replaced by a plane, the rest should be modified in the same manner, if not precisely in a similar degree; and the same with the edges;—we should at least expect to find them similarly modified, even though the degree should differ. Let us compare figure 9 with figure 5; the planes of the primary form, and those of the first, second, and third modifications are visible in both. Fig. 5 is perfectly symmetrical; while fig. 9, though symmetrical in one sense, is far removed from symmetry in the sense in which figure 5 is considered as being so: one half of the crystals is seen in each figure. In 5 six of the primitive planes are visible, in 9 only five; in 5 three planes of the first modification are seen, in 9 only one; in 5 there are four planes of the second modification, in 9 only two; in 5, ten planes of the third modification are seen, in 9 only two. It is not therefore that some planes are enlarged, so as to diminish others in size, but to their actual exclusion; and hence the want of that symmetry which might be expected when the primary crystal is a perfect geometrical solid. Indeed, this figure, together with the crystals represented by figs. 8, 10, 11,

Fig. 1.

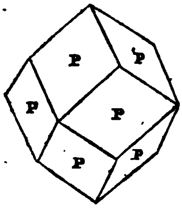


Fig. 2.

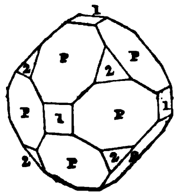


Fig. 3.

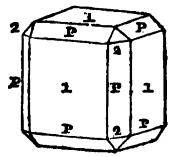


Fig. 4.

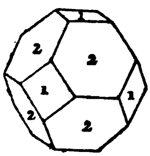


Fig. 5.

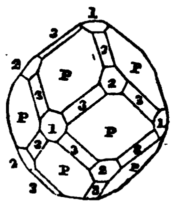


Fig. 6.

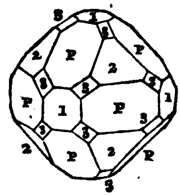


Fig. 7.

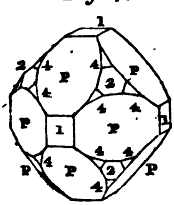


Fig. 8.

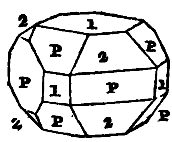


Fig. 9.

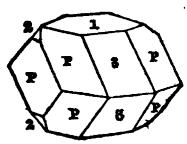


Fig. 10.

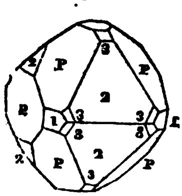


Fig. 11.

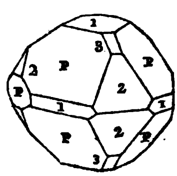
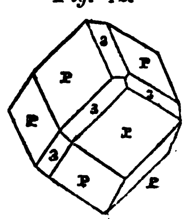


Fig. 12.



and 12, and several others which are not delineated, would have induced the suspicion that the primary form is not a perfect geometrical solid, if some of the rhomboidal dodecahedrons had not been sufficiently brilliant to shew, by the reflecting goniometer, that the adjoining planes meet at an angle of 120 degrees.

It may be said that these crystals are accidental, and ought not, therefore, to be figured in the series of the forms which this substance assumes. To this it may be replied, that some specimens consist only of crystals in these forms, and that if they were omitted, and if only such varieties were given as are perfectly symmetrical, it might be supposed to exist only in the latter; while such specimens as consist only of irregular crystals, might be supposed to belong to some non-descript species. I possess a specimen, of which the crystals belong to the variety described by figure 9, and which are not less in size than the figure itself. In general, however, the crystals vary in size, from the extremely minute to one-fourth of an inch in diameter.

The irregular crystals of this substance, and indeed of many other substances, of which the primary forms are regular geometrical solids, induce the conclusion that the giving to every crystal a descriptive designation, a plan adopted by the celebrated Abbé Haüy, would prove an endless and almost impossible, not to say, an useless, task. It cannot be denied that now and then these designations are intelligible in description; but if the plan be pursued to its extent, about six hundred names will be required for the crystals of the carbonate of lime alone. The most familiar, and upon the whole, the most intelligible, mode, would be to describe a crystal as possessing the planes of the first, third and fifth modifications, *&c.*; but even for this more simple method, crystallography is not yet far enough advanced in that department which consists in the delineation of all the known forms; until this be done, we cannot hope for a system built upon a generalization of the whole.

This substance usually occurs deposited upon other ores of copper, chiefly the iridescent and botryoidal varieties of copper-pyrites; it is sometimes accompanied by black copper, vitreous copper, and buntkupfererz.

It has been found in the veins of Dolcoath, Cook's Kitchen and Tin Croft copper mines near Redruth, and in Huel Virgin, Huel Unity and Huel Jewel, near St. Die. The specimen which has already been alluded to, as occurring in very large crystals, was raised about forty years ago, and is in the catalogue of my collection 'supposed to be from Treledra near Padstow;' the crystals are very thinly coated by copper-pyrites.

If, however, only one character of this substance were consulted, namely, its crystalline form, it might be assumed to be a variety of fahlerz; for the three planes which are found replacing each solid angle of the tetrahedral crystals of the latter, (Haüy, Pl. 70, o on o, Fig. 81.) meet under an angle of 120°, being precisely the same as that afforded by any two adjoining planes of the rhomboidal dodecahedron, in which form this mineral is found; but the superior hardness of this substance, as well as its fracture and specific gravity, and the effects resulting from the action of the blow-pipe, induce the conclusion that it ought not to be considered as a variety of Fahlerz; nor have any of the mines in which the mineral now under consideration have been found, yielded any tretrahedral crystals. It is to analysis that we must look to decide upon the difference between these minerals.

It is, however, extremely difficult to determine what the essential elements of the fahlerz are. A specimen analyzed by Chenevix, afforded 52 of copper, 23 of iron, and 14 of sulphur; and this being the most simple of the numerous analyses that have been made, (see Haüy, Tableau, p. 254), is almost sufficient to decide its essential elements to be copper, iron, and sulphur. A specimen from Airthrie in Scotland, analyzed by Thomson, afforded 19.2 of copper, 51 of iron, 15.1 of arsenic, and 14.1 of sulphur; while the several analyses of Klaproth shew, that it is sometimes composed in part of lead, antimony, or silver, occasionally even in considerable proportion, and in one instance of five per cent. of zinc. By all the analyses (ten in number) of this celebrated chemist, copper, iron, and sulphur appear to be the *only invariable constituents*; which tends to strengthen the conclusion that they are its essential elements; and that the arsenic, lead, antimony, silver, and zinc, although the

three first have been found to exceed in quantity the copper and iron, are only accidental ingredients; and therefore, since they do not affect the crystalline forms of the fahlerz, which are invariably tetrahedral, it may be inferred, that they are only mechanically mixed, not chemically combined with the copper, iron, and sulphur.

Art. XII. *Analysis of the Copper Ore, described in the preceding Paper.* *By* Richard Phillips, F.R.S.E. F.L.S., *&c.*

I. Having ascertained that the constituents of this ore are copper, iron, arsenic, and sulphur, I boiled 100 grains of it reduced to powder in nitric acid, until the whole of the metallic matter appeared to be dissolved. Fourteen grains remained unacted upon by the acid; of these a large portion was evidently pure sulphur; by heat nine grains were volatilized, and five remained, which were merely silica, that had been mechanically mixed with the ore.

II. The nitric solution was decomposed by potash, and being heated with excess of it, peroxide of copper and iron were precipitated together. This mixed precipitate was washed until it ceased to be alcaline, and was then dissolved in nitric acid. To the solution ammonia in excess was added; by this, peroxide of iron was precipitated, and the peroxide of copper held in solution; the former being separated, washed and ignited, weighed 13.3 grains, equivalent to 9.26 of iron.

III. The ammoniacal solution of copper was heated, and when the greater part of the ammonia was expelled, potash was added to the solution; and, by continuing the heat, peroxide of copper was precipitated, which being washed and ignited, weighed 56.6 grains, equivalent to 45.32 of copper.

IV. The alcaline solution obtained in III, and the water employed to wash the mixed precipitate of oxide of copper and iron, were evaporated together, and then saturated with nitric acid. This solution contained the sulphur and arsenic converted into acids, and combined with potash. Nitrate of barytes being added, sulphate

was precipitated, which, being washed and ignited, weighed 126 grains, equal, according to Dr. Wollaston's scale, to 17.14 of sulphur, which, added to 9, before obtained, =26.14. After this an accident happened to the solution, which prevented the separation of the arsenic acid; therefore,

V. One hundred grains of the ore were again treated with nitric acid; with the silica 11 grains of sulphur were obtained, and the nitric solution was decomposed by excess of potash as before, in order to separate the oxide of copper and iron.

VI. The alcaline solution being saturated with nitric acid nitrate of barytes was added to it, as long as precipitation took place. The precipitated sulphate of barytes being washed and ignited, weighed 150 grains, =20.4 sulphur, which, added to 11, separated without acidifying, =31.4; the mean quantity of this and the first experiment being 28.74.

VII. To the solution from which the sulphuric acid had been separated by nitrate of barytes, nitrate of lead was added as long as arseniate of lead was thrown down; and this, when washed and ignited, weighed 53 grains.

According to Dr. Thomson, 21.25 of arseniate of lead contain 7.5 of arsenic acid, equivalent to 4.75 of arsenic; if then, 21.25 give 4.75; 53 of arseniate of lead will indicate 11.84 of arsenic. It appears from these experiments, that this ore consists of nearly

Silica	5.
Iron	9.26
Copper	45.32
Sulphur	28.74
Arsenic	11.84
	100.16

In performing this analysis, some circumstances occurred which I think worthy of notice. In a preliminary experiment, I endeavoured to separate the copper from the iron by means of ammonia, without previously separating the arsenic acid; this I found impracticable, for it appeared that the arseniate of iron, at first precipitated, was eventually dissolved by the ammonia. In some treatises on chemistry, the arseniate of barytes is described as an insoluble salt: this, as may be deduced from

what I have stated, is not the case. I first tried it by pouring a solution of arseniate of potash into one of nitrate of barytes ; no precipitation occurred, but, upon standing some days, very delicate feathery crystals of arseniate of barytes were formed, which exhibited the prismatic colours with a splendour equal to that of the noble opal. I have since attempted, but without success, to reproduce the salt having this appearance.

Although the compounds of sulphur with copper and iron are well known, so much obscurity prevails as to the composition of the sulphurets of arsenic, that I shall not venture to offer any observations as to the mode in which these substances are combined ; but it will, I think, be evident, when the analysis, crystalline form, and other properties of this compound, are considered and compared with previously described copper ores, that it is essentially different from all of them. To mark this difference, as well as to offer a tribute of respect to departed merit and genius, my brother and myself propose to distinguish it by the appellation of TENNANTITE.

ART. XIII. *An Account of the violent and destructive Storm of the 23d of September*, 1815. *By* John Farrar, *Professor of Mathematics and Natural Philosophy in the University at Cambridge. From the American Philosophical Transactions.*

THIS storm was very severely felt throughout a greater part of New England. It was most violent on and near the coast, but does not appear to have extended far out at sea. It was preceded by rain, which continued to fall for about twenty-four hours, with a moderate wind from the N. E. Early in the morning of the 23d the wind shifted to the east, and began to blow in gusts accompanied with showers. It continued to change toward the south and to increase in violence while the rain abated. Between nine and ten o'clock A. M. it began to excite alarm. Chimneys and trees were blown over both to the west and north, but shingles and slates, that were torn from the roofs of buildings, were carried to the greatest distance, in the direction of about three points west of north. The greatest destruction took place between

half past 10 and half past 11. The rain ceased about the time the wind shifted from southeast to south; a clear sky was visible in many places during the utmost violence of the tempest, and clouds were seen flying with great rapidity in the direction of the wind. The air had an unusual appearance. It was considerably darkened by the excessive agitation, and filled with the leaves of trees and other light substances, which were raised to a great height and whirled about in eddies, instead of being driven directly forward as in a common storm. Charles river raged and foamed like the sea in a storm, and the spray was raised to the height of sixty or one hundred feet in the form of thin white clouds, which were drifted along in a kind of waves like snow in a violent snow storm. I attempted with several others to reach the river, but we were frequently driven back by the force of the wind, and were obliged to screen ourselves behind fences and trees, or to advance obliquely. It was impossible to stand firm in a place exposed to the full force of the wind. While abroad, we found it necessary to keep moving about, and in passing from one place to another, we inclined our bodies toward the wind, as if we were ascending a steep hill. It was with great difficulty that we could hear each other speak at the distance of two or three yards. The pressure of the wind was like that of a rapid current of water, and we moved about almost as awkwardly as those do who attempt to wade in a strong tide.

The effects of this storm in many places were very terrible; much damage was done to the shipping in most of the harbours from New York to Eastport. Many vessels went ashore and bilged, many were stoved to pieces against the wharfs and against each other. But the shifting of the wind prevented an excessive tide in most places. The sea had risen unusually high in Boston harbour two hours before the calendar time of high water. But the direction of the wind at this time tended to counteract the tide, and thus secured our principal seaports from that awful calamity which threatened them*. Considerable losses

* The town of Providence in Rhode Island was particularly exposed to the effects of this storm. The wind blew directly up the river on which it is built, unbroken by the cape or Long Island, and in sweeping over such

however were sustained by the wind alone; many old buildings, and such as were slightly built or particularly exposed, were blown down; great numbers were unroofed or otherwise injured; few entirely escaped. The greatest destruction took place among trees. Our orchards and forests exhibited a scene of desolation, which has never been witnessed before to such an extent in this country. The roads in many places were rendered impassable, not only through woods, but in the more cultivated towns, where they happened to be lined with trees. Many of the streets in Boston and the neighbouring towns were strewed with the ornaments of our finest gardens and fruityards. A considerable proportion of the large and beautiful trees in Boston mall*, and in the public walk near the grainery burying-ground, several of which measured from eight to twelve feet in circumference, were torn up by the roots and prostrated. Apple-trees, being separated at a considerable distance from each other, were overturned in great numbers. It was computed at the time, that no less than 5,000 were blown down in the town of Dorchester alone.

I have not been able to find the centre or the limits of this tempest. It was very violent at places separated by a considerable interval from each other, while the intermediate region suffered much less. Its course through forests in some instances was marked almost as definitely, as where the trees have been cut down for a road. In these cases, it appears to have been a moving vortex, and not the rushing forward of the great body of the atmosphere. Yet there seems to be no part of the coast of New England which escaped its fury. Toward the interior it

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an extent of water it accumulated a dreadful and most destructive tide upon this flourishing place. Vessels were actually driven over the wharfs and through the streets. A great number of stores and dwelling-houses were destroyed with their contents, and several lives were lost. The loss of property was estimated at several millions of dollars. The great calamity which befel this town, was rather owing to the extraordinary tide which rose twelve or fourteen feet above the usual mark of high water, than to the greater violence of the tempest in this place.

* It is worthy of remark, that in the several rows of trees constituting the mall, the leeward range suffered the most.

raged with less violence, and in Vermont and the western parts of New Hampshire, I am told that it was not noticed as particularly remarkable. Yet still further west on the St. Lawrence, the wind was so high as to render it extremely dangerous to be out in boats on the river. And what is still more remarkable, the storm began to grow violent at this place about the same time that it commenced near the Atlantic, and subsided about the same time.

There is something worthy of particular attention in the direction of the wind, at the several places where the storm prevailed. On the 22d, the wind appears to have been pretty generally from the N. E. The storm commenced, as is usual, to the leeward. But when the wind shifted from N. E. to E. and S. along the coast of New England, it veered round in the opposite direction at New York, and at an earlier period. It reached its greatest height at this latter place about nine o'clock on the morning of the 23d, when it was from the N. W. Whereas, at Boston, it became most violent about two hours later, and blew from the opposite quarter of the heavens. At Montreal the direction of the wind was the same as at New York, but did not attain its greatest height so soon by several hours.

The wind gradually subsided in the afternoon of the 23d, and before night the sky bore its usual appearance. It was observed soon after, that a singular effect had been produced upon the leaves of vegetables near the sea-coast; their vitality was destroyed, and they exhibited an appearance similar to that which is produced by a frost, except that they retained more of their original colour, and in some instances they assumed a darker hue. This was ascribed to the spray from the salt water, which was known to have extended many miles into the country from the circumstance of window-glass being covered with a thin coat of salt. The barometer descended very fast during the morning of the 23rd, and when the wind was highest had fallen about half an inch. It began to rise as the wind abated, and recovered its former elevation, about 29.90, by the time the air was restored to its usual tranquillity.

It is thought that there is no account of such a storm as this to be found in the history of this part of the country. We have had

hurricanes that have laid waste whatever came in their way, but they have been very limited. There was a remarkable storm of wind and rain on the 9th of October 1804, which in some respects resembled that above described. It destroyed a number of houses, overthrew trees, chimneys and fences, but it was much less violent and less destructive.

A very remarkable gale occurred in some parts of North Carolina on the 3d of September 1815, twenty days before the one which is so often referred to amongst us. It was preceded by a storm of several days with the wind from the N. E. The wind shifted on the 3d to the N. and W., increasing in violence. It began to subside as it approached the S. W. The tide rose in some places from ten to fourteen feet above high-water mark. The loss sustained at Wilmington and other places was similar to that which was experienced here on the 23d. The roads were impassable for several days on account of the fall of trees, and much damage was done to the crops of corn and tobacco.

ART. XIV. *Some experimental Observations on the Passage of Gases through Tubes. By* M. Faraday, *Chemical Assistant in the Royal Institution.*

In the third volume of this Journal, at page 354, I have noticed briefly some curious effects which take place when gases are passed through tubes by low pressures. They consist in an apparent inversion of the velocities; those which traverse quickest when the pressure is high, moving more tardily as it is diminished until they are among those which require the longest time in passing the tube; thus with equal high pressures equal volumes of hydrogen gas and olefiant gas passed through the same tube in the following times :—Hydrogen in 57″

Olefiant gas in 135″.5

but equal volumes of each passed through the same tube at equal low pressures in the following times :—

Hydrogen 8′ 15″

Olefiant gas 8′ 11″.

Again, equal volumes of carbonic oxide and carbonic acid

gases passed at equal high pressures through the same tube, occupied the

	carbonic oxide	133″
	the carbonic acid	156″.5
but at low pressures	carbonic oxide	11′ 34″
	carbonic acid	9′ 56″

I have lately had my attention again called to the subject, but have not yet been able to satisfy myself of the cause of this curious effect; nevertheless, as experiments do not always owe their value to the hypothesis which accompanies them, a few short observations on some made on this subject may be acceptable.

The effect is always produced by fine tubes at low pressures, but does not appear to belong to the mere obstruction by the tube to the passage of the gas, nor have I been able to produce it without a tube. A very fine needle-hole was made in a piece of platinum foil, and so arranged on a mercurial gazometer, that the pressure of a small column of mercury sent seven cubical inches of the following gases through in the times mentioned, namely—

Hydrogen 3′.8 nearly, taking a mean
Olefiant gas 9′.2

and when the pressure was increased, the same proportions in the times was observed. Other similar experiments gave similar results.

Slits, cut in platinum foil by the edge of a penknife, did not give so great a superiority to hydrogen as that mentioned above, and the proportion varied with different slits; still the hydrogen passed most rapidly, and a difference of pressure caused no difference in the relative times.

Three diaphragms were placed in different parts of the same tube, each being perforated with a small hole, but the effects produced in tubes was not observable here. Hydrogen passed in 3.8 minutes, and olefiant gas in 9.1 minutes.

The gases were passed through discs of paper, and the number of discs were increased so as to increase the obstruction, the pressure and quantity of gas remaining the same. With one disc of drawing-paper 6.5 cubical inches of hydrogen passed in 7′
of olefiant gas in 18′

with two discs the hydrogen passed in		15′.4
	the olefiant gas	38.
with three discs the hydrogen		22′.5
	the olefiant gas	57.75.

Lastly, for the effect of obstruction, I used a tube filled with pounded glass. This was uncertain, because on moving the tube it was impossible, almost, not to move some of the particles within, and then, of course, circumstances were changed; but by sending the gases through one after the other, results were obtained, the mean of which gave for hydrogen 3′.4

for olefiant gas 4′.7.

It would seem from these experiments that mere obstruction is not the cause of the effect observed in tubes, for when the tubes are removed, and obstructions which retard much more placed for them, the effect is lost; and, as the same aperture produces no difference of effect at high or low pressures, the variations between different apertures should probably be referred to some other cause.

I then endeavoured to ascertain some of the circumstances attending on tubes. Both glass and metal tubes produce the effect, and a metal tube, down which a wire had been thrust, did not seem to have its influence on the passage of gasses through it altered. The effect is heightened as the gas is made to pass more slowly through the tube; and this, whether the increased time be caused by diminished pressure, increased length of tube, or diminished diameter. This may be well illustrated by putting several very fine tubes together, for the particular effect is thus increased whilst the time is shortened. Two brass planes were ground together, and a few scratches made down one of them so as to form very fine tubes; through these olefiant gas passed in 26′.2, and hydrogen in 32′.5.

Three glass tubes were taken of different diameter, and cut into such lengths that they passed nearly equal quantities of hydrogen gas in equal times by the same pressure, their lengths were 42, 10.5, and 1.6 inches. The longer tube passed the

hydrogen in	3′.7, the olefiant gas in	2.75
the second	3.5	2.5
the smaller	3.45	2.8

and in several other experiments there seemed to be nearly an equal effect, when the quantity of gas passed in the same time was the same.

I imagined that the specific gravity of the gases might have some constant influence, but this does not seem to be the case: carbonic oxide and olefiant gas are nearly of the same density; and, if the effect depended upon their weight, it should be nearly the same for both of them; but this is not so, seven cubical inches of carbonic oxide required 4.6 minutes to pass through a tube which was traversed by the same quantity of olefiant gas under the same pressure in 3.3 minutes, each gas having been placed over caustic lime for some time previously; and oxygen required to pass through the same tube 5.45 minutes of time.

I placed three gauges in different parts of a tube, of such a size that it passed olefiant and hydrogen gas in nearly equal times; the gauges were very obedient to the pressure of the gas in the different parts of the tube, but I could not perceive any difference between the effect of the different gases.

These are some of the circumstances which affect and produce this curious effect: that the velocity of gases in passing through tubes should be in some proportion to the pressure on them is nothing particular; but the singularity is, that the ratio for the same gas varies with the pressure, and that this variation differs in different gases; thus the one which passes with the greatest facility at low pressure, passes with the least at high pressure.

It may be deduced from the experiments at high pressures and on obstructions, that the fluidity of the gas has little or nothing to do in this case, for, where it alone can have an influence, the indications are the same at all pressures, and the gas of least density passes in the shortest time; thus comparing hydrogen with olefiant gas, and considering its time 1, the time of the latter will be in the experiments already mentioned, as 2.38, 2.42, 2.4, 2.57, 2.46, 2.57, ratios, which do not differ much from each other, though the times, pressure, obstructions, and quantities of gas used, vary very considerably.

Neither is the variation among the different gases between the ratio of the velocity and pressure, connected with specific

gravity, at least I have not been able to observe such a connexion. I have quoted an experiment, or rather the general result of several, on carbonic oxide and olefiant gas, and it is adverse to the supposition; and in others, made on sulphurous acid gas and ammoniacal gas, still farther departures from the order of the densities were observed.

If a tube sufficiently fine and long be connected with a portion of gas under high pressure, so that the time occupied in its passage through it be considerable, the effect will be produced, *i. e.*, the times of different gases will vary from each other, but not according to their specific gravities; if the tube, however, be cut off so that the gases pass quickly, then the times will be as the specific gravity. Now, in the long tube, the pressure and velocity will vary throughout its length, the pressure being greatest at the internal or connected end, and least at the other extremity, whilst the velocity is least at the end towards the reservoir, and greatest at the other. But the ratio by which the pressure and velocity decrease and increase appears different for and peculiar to each gas. At the end of the long tube the olefiant gas issues more rapidly than hydrogen, though the pressure at the reservoir is the same; but shorten the tube, and let that part in which high pressures only exist confine the gasses in their passage, and the hydrogen gas will surpass the olefiant gas in velocity as far as 4 or 5 does 2. It would seem, therefore, that in the long tube the pressure or elasticity of the olefiant gas diminishes less rapidly than that of the hydrogen, or that its velocity increases more rapidly.

Perhaps these effects may be accounted for by the supposition of some power of expansion peculiar to each gas, which, if existing, a tube would for many reasons be well calculated to exhibit. The experiment requires numerous repetitions and much time, and I have not yet had sufficient to satisfy myself on the subject. I will, therefore, refrain from mixing up crude notions with facts, and at some more convenient opportunity endeavour to supply what is wanting in this paper.

Art. XV. *A Letter to the Right Hon. the* Earl of Liverpool, *proposing to remove the British Museum to the East Wing of Somerset House.*

My Lord,

The unfinished state in which Somerset House remains has long been a matter of *regret.*—The building of Waterloo Bridge and the opening of the new street have made it a matter of *reproach.*

The late Mr. Whitbread, no advocate for any unnecessary expenditure of the public money, declared several years ago, that it was disgraceful to the country to leave that edifice in the mutilated state in which it then was, and which the neighbouring improvements have since rendered so much more conspicuous.

It has also been pretty generally observed, even by the most cursory visitors, that the great national collection of the British Museum is very inconveniently placed in Montague House; and those who consider a little more deeply are seriously alarmed at the danger from fire or other accidents to which it is exposed in this old and rotten mansion.

Your lordship is aware that the state of this house is such as to expose its contents to considerable risk; and if it be not soon rebuilt, the antiquities will be a second time buried under a heap of ruins, and the books and papers may be lost for ever.

I need not insist on the value of this collection. In each particular department, it may be, I believe, rivalled by foreign countries, but *taken altogether*, it is, I will venture to assert, the most valuable in the world: and the manuscripts and books especially, connected with our political and constitutional history, are of such unparalleled importance, that I do not hesitate to say that a day ought not to be lost in determining to place the whole beyond the reach of accident. Great care is, I am aware, taken to guard against such a misfortune; but that is not, I humbly think, enough, as long as means exist of preventing the possibility of destruction by fire; and the consequences of a fire here are not to be calculated from what generally occurs in other

buildings. This old house, built according to the fashion of a hundred and fifty years ago, with a great deal of wood, and filled with books and papers, would blaze up like a tar barrel, and the whole would probably be in ashes before even the parish engines could arrive.

Nor is this a mere theoretic apprehension. Your lordship is aware that Montague House was burnt down within a few years of its original erection; and that a considerable part of the Cottonian collection was destroyed in 1731: nothing, indeed, but the most active and fortunate exertions saved that fine library which now forms so important a part of the British Museum. These considerations are the chief motives of this address, and your lordship will have already perceived it tends to a proposition to complete Somerset House by building the east wing fire-proof, and by transferring thither the British Museum. And I do not know to whom I could so properly address this proposition as to your lordship, who, as first minister, are more particularly interested in the public convenience and the splendour of the capital;—as head of the financial department, the expense of such a work is immediately within your province;—and as an official trustee of the British Museum, the security and splendour of that establishment must be peculiarly interesting to you.

These public grounds are, I hope, sufficient to excuse my taking the liberty of addressing you, without appealing, as I might do, to the personal qualities which assure me that I could not address myself to any one more capable of appreciating or more anxious to promote any plan which may be likely to conduce to the advantage of literature and the fine arts in this country.

If, indeed, I could hope to see a *distinct* and becoming edifice erected especially for the reception of the Museum, (on the site of the Mews, for instance,) I should not presume to offer my humble proposition; but I *know* that in the present state of the public purse, and, perhaps, of the public mind, such an expectation would be perfectly illusory; and under the pressing necessity of doing something very speedily, I cannot help suggesting the most practicable and economical expedient

which presents itself to me. I shall therefore proceed, in the first instance, to direct your lordship's attention to the state of Somerset House.

It has been stated, and, I fear, too truly, that the original plan and designs of this edifice are not forthcoming. It is supposed that they were considered as the private property of Sir William Chambers, the architect, and were privately disposed of after his death. I know not how this may be, but I know that I have not been able, with my best diligence, to obtain any thing more than an indistinct ground plan of part of the building; and that I have been informed that the general plans are not to be found in the public departments in which one might have expected to find them.

I shall, therefore, omit any criticisms on the original design, which in some particular parts can only be traced by conjecture, and shall merely observe that some of the most prominent faults in point of safety and convenience are probably not chargeable on the architect.

For instance, the internal parts to the right and left of the great entrance, abut so closely on the houses in the Strand as to be doubly liable to the danger of fire; first by their contiguity, and secondly, because, in case of fire, there are neither space nor means to apply the usual means of extinction; a most serious fault in a building destined for public offices, which, of course, contain many of the most important documents concerning the administration of the empire.

I shall say nothing of the ill effect which, in an architectural view also, the row of brick houses and shops abutting on and aligning with the *façade* produce; there is reason to think that Sir William Chambers designed to have continued the front streetward to the whole extent of the building, and that he intended entrances from the Strand into each of the two smaller courts, in addition to the great entrance into the larger court.

I must request your lordship to cast your eye on the plan of Somerset House and the adjoining ground, which accompanies this letter; on which your lordship will perceive that the north side, which is built in the rear of these shops, is extremely shallow, and that an ornamented and expensive front has been

thrown away (I must say) on a line of buildings, little more than 20 feet deep, and which are in absolute contact with, and danger as I before said, of fire from the houses and shops in the Strand.

This absurdity must have been produced, I suppose, by a spirit of false economy. The frontage to the Strand being very valuable, it was, I dare say, thought right to spare the Public the additional expense of buying it; without considering that the risk of fire in a situation to which no fire-engine could be led, and no exertion applied, might in one hour have rendered this short-sighted economy, a most expensive and irreparable calamity to the country.

Whether it may be advisable under the present (or any) circumstances of the country to incur the expense of insulating this edifice and extending the *façade* along the Strand to its interior extent, may well be doubted, when we consider that about thirty-two shops or houses, would be to be bought at an expense probably of £2,000 or £3,000 each; but I think I may here venture to assume, that both in beauty and security such a design would have been originally much preferable to that which was adopted, and that we ought to be on our guard in finishing the edifice (if it be ever finished) to avoid similar errors.

Your lordship will further observe, that even this internal north *façade* is not quite completed, though some *new work* has lately been done there, which I hail as a proof of your lordship's attention to this building, and of your desire to see it completed.

The south front, and its terrace to the river are perfect, except the eastern wing, of which, as I have just said, no part is built, and it unluckily happens that the work is broken off at a very remarkable place, and the effect produced by this truncated *façade* from the river and the bridges, is very bad; and I am sure that I do not say too much when I repeat the observation of every spectator, native or foreigner, that this imperfection—now rendered so striking by the neighbourhood of Waterloo bridge—is grossly offensive to the sight and not a little humiliating to our national reputation.

The space destined for this east wing is above 360 feet long, and about 62 feet wide, and the height to correspond with the rest of the building should be about 80 feet from the basement to

the roof. This whole space should be divided into three stories; thus forming three great galleries, each about 356 feet long and about 58 feet wide.

The lowest of these galleries ought to be appropriated to receive the collection of sculpture.

The middle gallery would form the library, and the upper gallery, the collection of natural specimens, the vases, medals, *&c. &c.*

The stairs to be constructed in the part connecting the east wing with the river *façade.*

As this is the main body of my proposition, I shall, before I enter into any details, here stop a moment, to assure your lordship that these three galleries would afford more, and I need not add, more convenient space, than the whole of Montague House, and all its additions and out-buildings (with the exception of the officers' houses) now do; nay, that the accommodation may be made twice as great as at Montague House; and that the expense will be trifling, compared with the erection of any other fit receptable for the Museum: for the edifice will be of plain brick with the exception of one end towards the Thames, which must be of cut stone to correspond with the other wing; but the expense whatever it be, will be considerably less than that of finishing the wing (which it is presumed must be done sooner or later) for any other purposes, on account of the subdivisions, *&c.*, which any other application of the space will induce; and I need not say how much more convenient, in every way, the new site would be to almost every class of persons whose curiosity or business should lead them to the British Museum.

The galleries themselves would be rooms of great beauty, inferior only to that of the Louvre in length, exceeding it in breadth, and on the whole, therefore, of a better proportion.

I will venture therefore to say, that even without considering the necessity of completing Somerset House, so great, so convenient, and so beautiful, a receptacle for the Museum, cannot *for any moderate expense* be found elsewhere; and I believe it might be shown that the cost would not greatly exceed that of the annual repairs of Montague House.

But I am well aware that great objects, however splendid or

useful, cannot make their way, if attention be not judiciously applied to some subordinate details; the gaudiest chariot cannot go on without its wheels, though in the eye of the hasty observer they contribute so little to the comfort of the owner, or to the splendour of the equipage; on those details I am prepared to enter, but I fear that it would be premature and tedious to do so here and at present. But without wearying your lordship, or making your name a pretence for wearying the Public, I shall say generally, that supposing the galleries built, there are still unfinished spaces in the edifice sufficient to afford full accommodation for the officers and all the secondary purposes of the institution. And the only inconvenience that could arise, would be the exchange of the lodgings of one set of public officers to the vacant spaces on the north and west sides, to make room for the officers of the Museum, in the immediate neighbourhood of their duties. These are little minutiæ, upon which I am ashamed to detain your lordship; but, as I said before, the chariot will not run without wheels.

But, my lord, at a very beneficial, and not very great, increase of expense, all these details might be rendered still more practicable, while the great objects of a national museum were further advanced both in convenience and splendour.

I mean, by recurring to a part of what I have already stated to be Sir William Chambers's original plan, and opening, by the purchase of three or four houses in the Strand, an entrance to the New British Museum, distinct from that of the public offices in Somerset Place.

Here I cannot help repeating the regret I have already expressed, that the whole of the houses in the Strand, in front of this great edifice, cannot be removed. No consideration, but of the expense, would, I believe, delay so obvious and so useful an addition to the security of Somerset House and the beauty of the city. But, at least, I hope it will not be thought extravagant to propose the purchase of three or four houses, which, at the rate at which those on the other side, where the new street now runs, were valued, would not exceed 10 or 12,000 pounds.

This space would afford a vestibule, or hall, for the Public,

with some apartments for the necessary officers or attendants; a second staircase, and other similar accommodations. But this is not all, there is still, between the eastern boundary of the building and Strand-lane, a space of ground belonging, as I understand, to the Public, where additions might with convenience be built, if accommodation cannot be found elsewhere; but, I am persuaded, that such accommodation *can* be found, and I should hope that this space would be kept open as a garden to the Museum.

I shall now, having thus opened my general views, take the liberty of leading your lordship through the two Museums in a little, and but a little, detail.

Montague House was built in 1676, and, as we learn from Mr. Evelyn, burnt down shortly after; it was, however, immediately rebuilt, and is now, I believe, the oldest inhabited house in London. The library is scattered through about sixteen small rooms, and the manuscripts are disposed of in five others, all wainscotted, lined, floored, and roofed, with combustibles, which remind one of Lord Nelson's remark, as he stamped upon the wooden floors of the palace of Copenhagen: "All this will burn! all this will burn!"

The Townley and Egyptian sculptures are disposed in a kind of gallery, resembling a series of differently shaped band-boxes, lately built, at a considerable expense; and the Elgin marbles, the pride of the Parthenon, are disposed in a temporary room built for the purpose, which resembles, in the style of its architecture and fitting, a stone-mason's shed. Athens, it has been said, was the cradle of the arts and their tomb; by a parody on this fine expression,—as a naked workshop was the cradle of those sublime sculptures,—so we make a kind of naked workshop their last abode.

My lord, I do not hesitate to say, that the meanness of that temporary building is revolting to every liberal and polished mind, and that the miserable penury which would not erect a fit receptacle for the works of Pericles and Phidias; (works they were—though not in the same immediate sense—of both these wonderful men,) is the ridicule of Europe, and the shame of England.

There, on a brick wall, bound together with rough deals, and daubed over, for ornament's sake, with a splendid solution of lime and rotten slate, hang the metopes and friezes of the Parthenon,

"Like a rich jewel in an Ethiop's ear."

My lord, I blush while I write, and I fancy that your lordship must feel some indignation as you read.—But it is said this room is *temporary*. Alas, my lord, it will, I venture to say, outlive by fifty years, the old house to which it is attached; and it is at least solid enough to perpetuate our absurdity for some sixty or seventy years. And not alone the absurdity of our taste, but the nonsense of our economy: the money laid out in the round, square, oblong, octagonal, and rhomboidal galleries of the Museum, would almost have finished Somerset Place; and if your lordship will have the goodness to call for the accounts, and to consult Mr. Vansittart, you will find, that to save a present expense we are paying an annuity of 20 per cent. upon the life of the British Museum; but our annuity differs from all others, in this respect, that when the patient dies, which must soon happen, we shall be obliged not only to bury him, and to provide houses for all his servants and family, but also to pay the whole of the principal money upon which we had for so many years paid this usurious interest.

Such is Montague House—such its present—such its probably future state; such its present—such its probably future expense. I shall now proceed to state what Somerset House is capable of affording, and at what probably comparative expense.

Your lordship is aware that the level of the Strand is considerably higher than the banks of the river, and the interior buildings of Somerset-place have a deep basement story of about thirty feet deep, so that the floor of this basement story is but a little higher than the bank of the river.

I would propose that the floor of the lowest gallery should be a few feet higher than the basement floor of the rest of the building, that it should be twenty-six feet high and vaulted, and that it should be lighted by semicircular windows at the top, in the same manner as the House of Lords. This would afford abundant light, and allow "a boundless contiguity of wall," to which

the Elgin and Phigalian friezes, and the other marble and terra cotta *reliefs*, now in the Museum, might be affixed, and which would afford room for any addition which we may be able to make to our collection of these interesting objects; whilst on the floor would stand the Elgin and Townly collection of statues, and thóse curious, though less elegant specimens of early sculpture which we have imported from Egypt; and I wish I could imagine the time when such a gallery, as that which I now describe, would be filled with adequate objects of curiosity or admiration.

Into this gallery we should descend by a number of steps from the level of the Strand, and ascend by a smaller number from the river; and to those who know any thing of the difficulties and dangers of transporting these immense blocks of marble, it will appear no slight advantage and œconomy, that any new objects can be thus conveyed by water-carriage to the very threshold of their final abode.

In this room, wholly built and vaulted with brick, and warmed by stoves, conducted under a marble floor, there could be no possibility of the accident of fire.

The middle gallery, or library, would be then but little above the level of the Strand; it would also be about twenty-six feet high, and three hundred and sixty feet long: and a floor either of plaster, tiles, or marble, resting on the vaulted roof of the gallery below, would protect it from all danger of fire from that quarter.

The internal arrangement would depend a good deal on the number of volumes for which space should be required; the means by which, in my opinion, the greatest quantity of space could be procured consistently with the light and beauty of the apartment, would be to have the windows only six feet distant from each other, and between each window a frame at right angles to the wall, carrying books on both its sides, something in the manner of the library of Trinity College, Cambridge.

I am aware, that if the present law of copyright should be continued (as I cannot doubt that it will be, at least as to the British Museum), provision must be made for a vast accession o.

books to the library; but, I am much mistaken in my calculation, if the mode I have proposed does not afford full room for double the number of volumes which Montague House now holds; and, I conceive, it is unnecessary to push computation farther at present. These book-frames, as well as the window-frames, should be of metal; and thus this invaluable and unique asylum of the literature of our country, and indeed of all other countries, would be absolutely secure from any danger by fire; and your lordship might inscribe over the door, as a mere truism, the hyperbole of Horace—" Exegi monumentum ære perennius."

For the upper gallery, I believe an iron floor would be necessary, because I conceive that the architects would not recommend vaulting at such an elevation, without the assistance of external buttresses, to support the walls on which the arches should rest. These buttresses might be objectionable, as darkening the galleries below, and as inconsistent with the style of the rest of the building; but your lordship is not now to learn, that floors of perfect strength and beauty have been erected in several places within the last few years, consisting of iron joists and beams, with either iron plates, or what is perhaps still better, stone or marble flags laid upon them.

This gallery would hold, I fear, ten times the number of articles of the kind for which I propose it, which the Museum possesses; but it might also be made applicable to another and a most desirable purpose. As it might be lighted from the top, the walls would be uninterrupted by windows, and entirely disposable, and here might be established a national gallery of pictures.

I am aware of the objection which the painter and the naturalist will make against thus combining their several, and, it must be admitted, very different, objects; and I wish we could afford to each class a separate apartment: but I know not how, with public convenience and public economy, this can be accomplished; while, on the other hand, I confess that the union of the two classes appears to me likely to produce little interruption to the amateurs of either.

They are neither of them objects of deep study; they do not require from their admirers that meditation which the severer

sciences exact. The student in mineralogy and the student in painting may pursue their occupations without mutual disturbance; and the cases of natural specimens ranged along the walls, and about three feet high, as they are now at the Museum, will not in any degree interrupt the view of the pictures which hang over them, while they will guard them from the fingers of the ignorant or mischievous, and will serve for the same purpose of protection which in the gallery of the Louvre they have been obliged to seek in a brass railing.

But I do not insist on this part of the proposition; the space may be found necessary for the collection; besides, there is no picture-gallery in the present museum, and I am only bound to find an equivalent for that building.

This gallery would be like the others, about 360 feet long, the side wall would be about twenty-four feet high, and the coved ceiling would add about some feet more to its height.

The ceiling and sky-lights of this gallery, and the roof of the whole, should also be composed of cast-iron or metal beams, rafters and frames; and the entire building would then present, I venture to assert, an incombustible receptacle, unequalled in extent, convenience, and beauty, for the objects of literature and the arts which should be disposed within it.

Having thus laid before your lordship a hasty and general, but I hope not vague, view of the edifice and its distribution, I feel that I have now to approach the most pressing part of the subject; I mean the expense. But upon this I hope, as I have already hinted, to be able to suggest some satisfactory considerations to your lordship.

1. The first arises out of what I have already said of the risk to which the Museum is exposed in its present situation, and its perfect and eternal security in that which is proposed; and I should hope that even some additional expense might be considered, (to speak in a language well understood in England,) in the light of an *insurance*, effected upon the literary warehouse of the nation.

2. I think the Public is not so poor but that it would be willing to pay something towards advancing the splendour and honour of the country, in a particular in which foreign nations have hitherto found us most deficient.

3. It should be recollected that whatever is spent on this object is (to use another metaphor familiar to mercantile feelings) *laid out to interest.* The expense of the edifice is distributed amongst ourselves,—not to the drones of society, but amongst our most estimable artizans.

> " Hence are the naked clothed,—the hungry fed.
> Health to himself, and to his children bread,
> The labourer brings"———

But that effect is only temporary; the *eternal interest* of this expense will be paid by the learned, the skilful, and the ingenious. To the scholar, the artist, and the philosopher, new sources of industry and ingenuity will be opened; and the assemblages of all the arts and sciences will give a new spring to the elegance of British taste and the vigour of British intellect.

4. But what, perhaps, may appear still more satisfactory than mere theoretical reasonings, (however well founded) is, that I believe there will really and ultimately be no increase of expense.

The edifice I propose, will be of the most lasting materials, and may be expected to last a century, without the necessity of any considerable addition or repair. Set against this the eternal and eternally-increasing drain for the repairs of Montague-House; and consider the sums which in these last few years have been expended in additions to it; and consider further the addition which every accession of literary wealth will render necessary; and, finally, that in a few years it must be rebuilt altogether, or some other edifice be found to replace it.

5. Recollect also, my lord, that the ground at Somerset House is now lying waste and wholly unproductive, whereas the site of Montague House has become wonderfully valuable.

Ask his Grace the Duke of Bedford how much he has improved his estate, by pulling down old Bedford-house, and erecting on its site, Bedford-place, Russel-square, and the new buildings in that neighbourhood; and I think your lordship will find that the sale of Montague House and gardens, would go a great way to defray the expense of the new Museum; and, in addition to all this, remember that I propose nothing more than the completion of Somerset House, a measure long called for by the country, and which will undoubtedly, one day or another, be

carried into effect, though never probably on such good terms or for such popular and beneficial purposes as that which I now propose.

There are some other matters connected, though not immediately, with this subject, and particularly the situation of the Royal Academy, to which I should feel desirous of calling the attention of your lordship and the Public; but I am unwilling to enter into any minor topic, or to impair the simplicity and unity of the proposition which I lay before you by extraneous considerations.

I know that a crowd of little interests will arise against any plan of this nature; one man is comfortable where he is, and does not choose to be disturbed; another looks from his back drawing-room, upon Montague Gardens, and shudders at the thoughts of his prospects being interrupted; a fourth lives in Thorney-street, and finds the neighbourhood of the Museum so convenient; a fifth, poor man, looks to getting a slice of the east wing of Somerset House when built; and a sixth will remind your lordship, that Sir Robert, one of your lordship's predecessors, used to say *quieta ne movere.*

The latter class of advisers are so much to my own taste, that if they could assure me that the roof of Montague House would not *move* in spite of us; or a fire not reduce us to literary beggary in a single night, I should, I think, not have troubled your lordship with this letter. But as the change is sure to take place sooner or later, it belongs to your lordship to give it in a proper direction, and to take care, by a timely precaution, and wise liberality, that the riches and honour of the nation are put out of the jeopardy of a *falling house.* In such cases, we know by experience, that the moderns can take care of themselves; but Phidias is now like his own Niobe, turned to stone,—Homer is without a guide,—and we cannot hope that the Editio Princeps of Pliny will escape, with a pillow on its head, from the crumbling roofs of Montague House.

I have not entered, as I might have done, with, I believe, some degree of effect, into the details of the expense; your lordship would not, and could not, act on any calculations of mine; all that I can hope is, that the general statement which I have made, may induce your lordship to take the matter into consi-

deration, and to consult, upon the details, with those whose professional characters are better intitled to the confidence of your lordship and the public.

I have the honour to be,
My Lord,
Your Lordship's most obedient humble servant,
J. W. C.

Art. XVI. *Some Observations on the Opinions of the Antients respecting Contagion. By* G. D. Yeats, M.D., *Fellow of the Royal College of Physicians, &c. &c.*

An opinion having been promulgated that the antients disbelieved in the doctrine that fevers were contagious, that is, that the disease was propagated from one individual to another by contact, it appeared to me a matter, at least, of curious, if not of useful, research, to inquire how far this opinion was founded in truth. They who will take the trouble to turn over the pages of the antient historians and poets, will soon find that the description of fevers, both by medical and historic writers, clearly shews that it was the generally-received opinion, that human bodies conveyed to each other febrile infection of a highly malignant nature; and further, it is stated, that diseases were propagated by contagion and infection from brutes to the human race. It would be a matter of grammatical hypercriticism to give the etymology of the word contagion, which, of itself, as so closely connected with its Latin derivation, is sufficient to shew what was the idea entertained of the mode by which some diseases were conveyed from one individual to another. It will not be necessary to look into histories more early than that of Thucydides, although it is related that, after the destruction of Troy, a pestilential disease raged in Greeee and the neighbouring countries of Asia; and Herodotus attributes it to the miseries consequent to, and connected with, the Trojan war.

In the second year of the Peloponnesian war, which scourged Greece for twenty-seven years, and which commenced about four hundred years before the Christian æra, a raging pestilence broke out in Athens—An invading army of sixty thousand men covered

the beautiful plains of Attica, and compelled thousands of the inhabitants to seek protection within the walls of the already-populous and crowded cities; thus generating and increasing, by a pollution of the air in confined habitations, pestilential disease; accordingly, as Thucydides says, ἡ νόσος επινείματο δε Ἀθήνας μὲν μάλιϛα, ἔπειτα δὲ και των ἄλλων χωρίων τὰ πολυ ανθρωπότατα. —*Thucydid. Hist.* lib .ii. p. 134. Francofurti, 1594.

"This pestilent disease raged chiefly at Athens, and also in other places where the inhabitants were the most crowded. Diodorus Siculus, in his account of the same pestilence, declares the opinion that the disease arose in consequence of the unusual crowded state of Athens—οἱ δ' Ἀθηναῖοι πάρατάξασθαι μεν οὐκ ετολμων, συνεχόμενοι δ' ἐντὸς των τειχων, ἐνέπεσον εἰς λοιμικὴν περίϛασιν. πολλȣ γαρ πλήθους καὶ παντοδαπου συνεῤῥυηκοτος εἰς τὴν πόλιν, διὰ την ϛενοχωρίαν εὐλόγως εἰς νόσους ἔπιπτον, ελκοντες ἀερα διεφθαρμενον. Lib. xii. p. 101. "The Athenians, not daring to meet the Peloponnesians in open battle on the plain, remained cooped up within their walls, and caused pestilential effluvia; for great multitudes of people from all quarters congregating in the city, very readily generated disease by breathing a corrupted air."—The eloquent and animated description which Thucydides gives of the symptoms, clearly describes a fever of the most violent kind. It was attended with such violent thirst and evolution of animal heat, that the miserable sufferers threw themselves into the sea, into ponds, and even into the wells, to quench their thirst and raging heat. The art of the physicians not only was of no avail, but they themselves, and all who approached the sick, were cut off by the contagion—ἀλλ' ἀυτοὶ μάλιϛα ἔθνησκον ὅσω καὶ μαλίϛα προσήεσαν. P. 129.—Such was the dread created by thus catching the contagion that people were unwilling to attend the sick; there was a mutual fear of visiting each other, and whole families perished in consequence of want of assistance; and they who braved the danger, from a principle of virtuous affection in attending their sick friends, perished in heaps—καὶ ὅτι ἕτερος ἀφ' ἑτέρȣ θεραπείας αναπιμπλάμενοι, ωσπερ τα πρόβατα ἔθνησκον· καὶ τὸν πλειϛον φθόρον τȣ̃το ἐνεποίει. εἴτε γὰρ μη θελοιεν δεδιότες ἀλλήλοις προσιέναι, απωλλυντο ἔρημοι, και οἰκιαι πολλαὶ ἐκενώθησαν ἀπορία τȣ θεραπεύσοντος, εἴτε, προσίοιεν, διεφθείροντο, p. 132. Thus

then, it appears clearly from the account of Thucydides that the contagion not only spread from one individual to another, but what is very remarkable, as shewing the belief of the virulence of the disease caught in this way, he adds, that the greatest part of the mortality was produced by this communication of the contagion—καὶ τὸν πλεῖστον φθόρον τῦτο ἐνεποίει, and in the popular clamour which was raised against Pericles for involving his country in the destructive Peloponnesian war, he was accused, says Plutarch, of giving more violence to the pestilence which raged at Athens, by keeping the people cooped up like herds of cattle to be infected with contagion from one another ἀλλ' ἐᾶν ὥσπερ βοσκήματα καθειργμένοις, ἀναπίμπλασθαι φθορᾶς ἀπ' ἀλλήλων. Plutarch, vita Periclis.

Aristotle, the son of a physician, has in one or two of his problems, proposed questions for reasons why diseases should be propagated from a diseased person to a sound one who approaches him. So prevalent was the opinion of the contagious nature of pestilential diseases, that he puts it down as a problem—Διὰ τι ποτε ὁ λοιμὸς μόνη τῶν νοσων μάλιςα τυς πλησιάζοντας τοῖς θεραπευομένοις προσαναπίμπλησιν; ἢ ὅτι μόνη των νόσων κοινῆ ἐςιν ἅπασιν. ὥςε διὰ τυτο πᾶσιν επιφέρει τον λοιμὸν, ὅσοι φαυλως ἔχοντες προϋπάρχυσι, καὶ γὰρ διὰ τὸ υπεκκαυμα τῆς νοσυ της παρὰ τῶν θεραπευομενων γινομένης, ταχέως υπὸ τῦ Πράγματος ἁλίσκονται. Sect. 1, Prob. vii.

"From what cause does it happen that the plague alone of all diseases especially infects those who approach the persons labouring under it? Whether is it that, of all diseases, mankind are more susceptible of it? Therefore, on this account, the plague attacks all who, being of a bad habit, are first seized with it; for a fomes of the disease being generated in those labouring under it, others are quickly infected with it."

No doubt can possibly be entertained here of the opinion respecting the contagious nature of plague; on the contrary, the opinion is so established and believed, that it is asked, why it should be so? It is also not a little curious, that Aristotle should state, that the plague first commences in those who are of a bad habit of body; or, to speak in modern language, he conceived a predisposition of the constitution rendered the body more susceptible.

The constitution, being thus impregnated with disease, generated a fomes, which readily communicated the contagion to another. I take υπεκκαυμα to be very expressive in this way. Thus we have the complete modern doctrine explicit and clear in a single problem of Aristotle, the susceptible predisposition of the body in taking infection, the generation of a fomes, or infectious principle, readily communicating the disease to others by contact. In the eighth problem of the seventh section are some more explanations on this point; in which he observes, all are easily affected with such diseases as arise from a corrupted source, such as pestilences, for they who approach such are immediately infected, ὁ δε πλησιάζων τοιῦτον ἁνάπτει.

In various parts of Diodorus's history, we find accounts of pestilential diseases as they occurred in different parts of the world, particularly among multitudes of people collected together for the purposes of war. A contagious pestilence broke out at Carthage at the time it was invaded by Dionysius, the tyrant of Syracuse. Diodorus, in his account of this pestilence, the symptoms of which he has described, particularly points out the infection and fatality produced by approaching the sick:— μετα δε ταῦτα διὰ τε τὸ πλῆθος των νεκρων και το τοὺς νοσοκομοῦντας ὑπὸ τω νόσω διαρπάζεσθαι, ουδεὶς ετολμα προσιέναι τοῖς κάμνουσι.

"As the mortality caused by the disease was great, and as the attendants upon the sick were cut off by it, no one dared to approach the infected.—Again:

Καὶ γὰρ οἱ τοῖς κάμνουσι παρεδρεύοντες ἐνέπιπτον εἰς τόν νόσον παντ ες ὥστε δεινὴν εἶναι τὴν συμφορὰν των ἀρρωστούντων, μηδενὸς θέλοντος ὑπηρετεῖν τοῖς ἀτυχουσιν, οὐ γαρ οἱ μηδὲν προσήκοντες ἀλλήλους ἐγκατέλειπον, αλλ αδελφοὶ μὲν αδελφοὶς, φίλοι δὲ τοὺς συνήθεις ἠναγκάζοντο προίεσθαι διὰ τὸν ὑπερ αὑτων φόβον.

"For all took the disease who had close communication with the sick, so that wretched indeed was the condition of those who were diseased; every one being unwilling to assist them, for not only they, who were not bound by any tie of relationship, deserted each other, but brothers and friends were compelled to neglect their nearest relatives and companions, on account of their dread of the contagion."

In various parts of the history of the Romans, by the Halicarnassian historian, we find accounts of pestilential fevers which spread havoc and destruction around; and we not only can discover that these fevers were infectious, by the manner in which they spread, but Dionysius expressly tells us, that they who touched, or lived with, persons so diseased, became infected. In the 451st year before the Christian æra, and about 300 after the building of the city, a contagious fever broke out in Rome— Λοιμικὴ νόσος εἰς τήν Ρώμην κατέσκηψε, μεγίςη των εκ τυ προτέρυ χρόνυ μνημονευομένων υφ᾽ ης οἱ μεν θεράποντες ὀλίγυ εδεησαν ἅπαντες ἀπολεσθαι, των δὲ ἄλλων πολιτῶν ἀμφὶ τυς ἡμίσεις μαλιςα διεφθάρησαν, υτε των ίατρῶν ἀρκύντων ἔτι βοηθεῖν τοῖς καμάτοις, ὔτε οἰκειών ἤ φίλων τα᾽ναγκᾶια ὑπηρετυντων οἱ χαρ επικυρεῖν τᾶις ἑτέρων βυλόμενοι νόσοις, απτόμενοι τε καματηρων σομάτων, και συνδιαιτώμενοι τὰς αυτὰς ἐκείνοίς νόσυς μετελαμβανοι. *Dionysii Halicarnassensis Historia.* Oxoniæ, 1704. p. 645.

"The most pestilential disease ever remembered, brought destruction upon the city, by which almost all those affording assistance were cut off, and nearly one half of the other citizens were destroyed; neither were the physicians able to attend effectually the sick; nor the friends and domestics to administer the necessaries; for they, who willingly attended others, by touching their diseased bodies, or dwelling with them, were seized with the same malady."

Here we have both contagion and infection clearly stated; the former communicated by touching the diseased bodies, the latter giving disease to those who came within the concentrated sphere of its action. The miserable condition of the city during the ravages of this pestilence is pathetically described by Dionysius.— The stench from the unburied dead bodies, which were cast into the sewers, on the highways, and into the river, and again thrown by the tide upon its banks, contributed to maintain the disease by spreading the infection; for such was the desolation, that whole houses were deprived of their inhabitants by death. The contagion was carried into the country, where numbers perished; and the Æqui, the Volsci, and the Sabines, enemies of Rome, desirous of taking advantage of the distresses of the city, by invading it,

received the infection, and carried destruction into their own habitations. The yeomanry of the country were either destroyed, or paralysed by the febrile infection; the ground remained untilled, and famine was added to pestilence.

Interspersed in various parts of Livy will be found histories of pestilential fevers, the infection of which, it is expressly stated, was spread by contact. About the year 389, A. U. C., a fever of this kind broke out in Rome.

"Grave tempus et fortè annum pestilens erat," says Livy, urbi agrisque nec hominibus magis quam pecori; et auxere vim morbi terrores populationis, pecoribus agrestibusque in urbem acceptis. Ea colluvies mistorum omnis generis animantium et odore insolito urbanos et agrestem confertim in arcta tecta æstu ac vigiliis angebat, ministeriaque invicem et contagio ipsa vulgabant morbos." Lib. 3. c. vi. p. 47.

Again, in the account which Livy gives of the fever which broke out among the soldiers during the siege of Syracuse, a siege ever remarkable by the death of Archimedes, it is clearly stated, that contact of the sick propagated the disease.

"Accessit et pestilentia, commune malum, quod facile utrorumque animos averteret a belli consiliis, nam tempore autumni et locis naturâ gravibus, multo tamen magis extra urbem quam in urbe intoleranda vis æstûs per utraque castra omnium fermè corpora movit, et primo temporis ac loci vitio et ægri erant et moriebantur, postea curatio ipsa et contactus ægrorum vulgabat morbos; ut aut neglecti desertique, qui incidissent, moriuntur aut assidentes curantesque eâdem vi morbi repletos secum traherent." Lib. xxv. c. 26. Carthaginians, Romans, Sicilians, all fell victims to the disease.

So prevalent indeed was the opinion of the contagious nature of pestilential fever or plague, that we find in medical writings, when the authors wish to represent the infectious nature of disease, they compare it to the plague. Thus Aretæus, one of our best and most accurate professional writers, in giving an account of the nature of Elephantiasis, and wishing strongly to impress on his readers the idea of its highly contagious nature, says,—ἀτερπὲς μὲν καὶ φοβερὸν, θηρίῳ γὰρ ἰδέῃ, δεινὸς δὲ ξυμβιῶντι καὶ ξυνδιαιτᾶσθαι,

ȣ μεῖον ἢ λοιμῷ· ἀναπνοῆς γαρ ες μετάδοσιν, ῥηιδίη βαφή.—Θεραπεια Ελεφαντος.

"It is a terrible and unsightly disease, putting on the appearance of the beast: there is great danger too in taking food with one so diseased, as much as with one afflicted with the plague, for the infection is readily caught by a reciprocity in respiration."

Galen, too, in his first book, chapter iii. *De Febribus*, not only alludes to, but directly asserts, the contagious nature of the plague; for he says, in strong language, there are none, possessing any understanding, who do not know that a pestilential condition of the air will produce fevers, as also that it is very imprudent to have any direct communicatian with those afflicted with the plague, on account of the danger of catching it, in like manner as in the itch, or inflammation of the eyes—καὶ μεν δὲ καὶ ὅτι λοιμώδοις ἀέρος καταςις ηνεγκε πυρετον, ȣδὲ τȣτο αγνοȣοσιν, οις μέτεςι συνεσεως· ωσπερ γε καὶ ὅτι συνδιατρίβειν τοῖς λοιμωτοισιν επισφαλές απολαυσαι γαρ κίνδυνος ὥσπερ ψώρας τινός ἢ οφθαλμιας.

It may not be incurious to remark here, that ophthalmia is said to be contagious; and Aristotle asserts the same thing in the eighth problem of the seventh section. What is the reason, he says, that they who have close intercourse with persons labouring under the itch or ophthalmia, are seized with it?—Διὰ τί απὸ φθίσεως και ὀφθαλμιάς και ψώρας οι πλησιάζοντες ἁλίσκονται.

The Public are well acquainted with the discussion which has taken place respecting the contagion of that species of ophthalmia, which so sorely afflicted our army in Egypt.

In the sixth chapter of the fourteenth book of the history of Ammianus Marcellinus, where he describes the vices of the people of Rome, he alludes to a disease of a highly infectious nature, at a period of time about three hundred and fifty-three years after the birth of our Saviour. It appears to me to be almost impossible to say what the disease was, but it is sufficient to state that the account describes it to be so exceedingly infectious, that the servants sent to inquire after those who were ill, were ordered to undergo purification before they returned home. "Et quoniam apud eos, ut in capite mundi, morborum acerbitates celsius dominantur; ad quos vel sedandos omnis professio medendi tor-

pescit: excogitatum est adminiculum sospitale, ne quis, amicum perferentem similia, videat: additumque est cautionibus paucis remedium aliud satis validum, ut famulos percontatum missos quemadmodum valeant noti hâc ægritudine conligati, non ante recipiant domi, quam lavacro purgaverint corpus. Ita etiam alienis oculis visa metuitur labes." Here we have not only the dread of contagion being communicated from one individual to another, but precautions were taken to prevent the infection being carried by the clothes or person of a second individual to a third. Whatever particular condition or nature of disease "labes" may be supposed to mean, it is, nevertheless, perfectly clear that an infectious principle, communicable through the medium of another, was feared and avoided. Ammianus, however, in the fourth chapter of the ninth book, describing a pestilence which raged at Armida in Mesopotamia, when it was besieged by Sapor, king of Persia, A. D. 359, and in giving the different opinions which were held respecting the origin of pestilential diseases, makes the following observations, in which "labes" is evidently used as disease. Adfirmant etiam aliqui, terrarum halitu densiore crassatum aera emittendis corporis spiraminibus resistentem, necare nonnullos: quâ causâ animalia præter homines cætera jugiter prona, Homero auctore, et experimentis deinceps multis cum talis incesserit labes, ante novimus interire."

To the facts, which have been adduced from medical and historical writers respecting contagion, may be added the descriptions and opinions of the poets. The classical reader will feel a pleasing interest in bringing to his recollection the readings of his earlier days; and will, therefore, be gratified by the perusal of quotations from the writings of those authors whom he has probably often had in his hand. In the beautiful description from the first eclogue of Virgil, where he characterizes himself under the name of Tityrus, and the Mantuans under that of Melibœus, (who had been spoiled of their lands to enrich the followers of Augustus) the latter thus addresses him:—

> Non insueta graves tentabunt pabula fœtas
> Nec mala vicini pecoris contagia lædent.

Thus, as on a subject well known, Melibœus congratulates

Tityrus that his cattle will not be exposed to the contagion of a neighbouring herd, as by the interest he had, through Mecænas, with Augustus, he was permitted to retain his Mantuan property, and was not, therefore, obliged to remove his flocks to other and untried pasturage. In the third book of the Georgics, Virgil is still more explicit and clear respecting the contagious nature of disease in cattle, for he describes the symptoms of one becoming ill, and desires it may be immediately attended to.

Priusquam
Dira per incautum serpant contagia vulgus.

The other Roman poets of nearly the same period are equally descriptive and explicit in their accounts of pestilential diseases, as propagated by contagion, as we read in the pages of Lucretius, Ovid, Lucan, and Silius Italicus. I cannot avoid the pleasure of quoting, from the two former at least, their highly poetical descriptions. Lucretius, in his beautiful account of pestilential fever, unquestionably taken from the historical statement of Thucydides, evidently describes its infectious nature. Its malignancy and rapid propagation from one individual to another, by contagion, are unequivocally stated.

Quippe cum nullo cessabunt tempore apisci
Ex aliis alios avidi contagia morbi
Lanigeros tanquam pecudes et bucera sêcla;
Nam quicunque suos fugitabant visere ad ægros,
Vitai nimium cupidi mortisque timentes
Pœnibat paullo post turpi morte malâque,
Desertos ope expertes Incuria mactans,
Qui fuerant autem præsto contagibus ibant.

Ovid, in the seventh book of his Metamorphoses, gives an animated and highly poetical account of the plague which raged in the island of Ægina; and we find the symptoms and calamitous circumstances attending the disease similar to those as described by the masterly pen of Thucydides; we must therefore conclude that it is either a fiction of the poet's, as a copyist, or an account of a disease, similar to the Athenian pestilence, as it occurred in an island of the Grecian Archipelago. However that may be, the idea of the contagious nature of the pestilence is determined and unequivocal,

clearly shewing that the poet is stating an opinion generally received in his and the preceding times. After describing the calamitous havoc caused by the spreading of the disease, the fields and roads being strewed with the bodies of the dead, the air corrupted with the effluvia of the putrefaction, he adds, the contagion is thus spread far and wide:

> * dilapsa liquescunt
> Afflatuque nocent et agunt contagia latè.

Human aid is of no avail, for the faithful attendant, in his solicitous care of the sick, by a near approach catches the contagion, and is thereby hastily hurried to his grave.

> Nec moderàtor adest inque ipsos sæva medentes
> Erumpit clades, obsuntque autoribus artes;
> Quo proprior quisque est, versitque fidelius ægro
> In partem lethi citius venit.

Instead, then, of having any doubts on the opinions of the antients respecting the propagation of disease by contagion and infection, we have ample proof from the writings of their philosophers, physicians, and poets, not only of the existence of such an opinion, but of precautions taken to prevent the spreading of the infection. In the reading, however, which I have gone through, I do not recollect to have met with a passage describing any strictly precautionary means except in Ammianus Marcellinus. I am, nevertheless, inclined to believe, that by a deeper perusal of the antient Greek and Roman authors, we should find that methods were adopted for preventing the communication of contagious miasma; not, however, with that philosophical accuracy and success which the improvements in modern science have produced. Many works, besides those I have read, remain to be examined, as well as a more critical perusal of them; but what I did read was so much to the point, and so satisfactory, that it was unnecessary to proceed further.

* Scilicet Corpora.

Art. XVII. *History of the Plague that raged in* Moscow *in* 1771.

[As a Committee of the House of Commons is now sitting for the purpose of examining evidence as to the contagious or non-contagious nature of the plague, and the consequent propriety of continuing or abolishing the Regulations of Quarantine, we think the following account of the ravages of that dreadful disease, in one of the most populous cities of Europe, cannot fail to be read with considerable interest. It is a translation of the historical part of a Memoir, written by Dr. Mertens, under the title of *Traité de la Peste, contenant l' Histoire de celle qui a regné à Moscu en* 1771. *A Vienna et a Strasbourg*, 1784.

The author has given a most candid and impartial recital of the melancholy events he was an eye-witness of, without any theoretical speculations, and he appears to have clearly established the following very important conclusions :

1. That the plague was introduced into Moscow by two soldiers, who arrived there from the frontiers of Turkey, where the Russian army was then engaged in warfare, and who died of that disease in the military hospital of that city. By them it was communicated to some of the attendants on the sick in the hospital ; and finally, from these latter, most of whom died also of the plague, it spread into other quarters of the town.

2. That the physicians of the military hospital immediately recognised the nature of the disease, and adopted such measures of precaution, that they soon succeeded in extinguishing it altogether in that establishment.

3. That the judicious and rigid quarantine enforced by Dr. Mertens, with regard to the Imperial Foundling Hospital, situated in the centre of the city, completely prevented the admission of the plague into that building, where the children continued to enjoy perfect health, amidst the havoc occasioned by the pestilence around them.

4. That the greatest mortality, which amounted in the last month to 1,200 daily, was to be attributed to the ignorance, obstinacy, and blind superstition of the lower orders of the people, who neglected all precaution, and, considering the malady as a scourge from Heaven, thought the Divine vengeance was only to be averted by the performance of their religious ceremonies, which necessarily exposed them to the danger of infection, from the promiscuous intercourse consequent on their observance.

5. That the plague may exist, and rage with the greatest fury, in northern climates, where, contrary to the usual observation made in the

East, it is not checked by the heats of summer (rising frequently in Moscow to 95° Fahrenheit), but is most decidedly arrested, and finally extinguished, by the severe frosts in winter.] EDITOR.

At the beginning of the 17th century the plague had ravaged for the last time, the city of Moscow, since which it had not appeared there. During the war with the Turks in 1736, it had declared itself among the Russian garrison of Oczakow, from whence it was carried into the Ukraine, but, at that period, it did not penetrate further.

In 1769, war began again between the Russians and Turks, and we learned the following year, that the Turks had brought the plague into Wallachia and Moldavia; that it exercised its ravages there, and that many Russians had died in the city of Yassy, of a disease, which, at the beginning, some called a malignant fever, but which the most skilful physicians acknowledged to be the plague. The Baron d'Asch, the first physician of the army, gave in German, the description of this malady, in a letter to his brother, a resident doctor at Moscow, who communicated it to me. "It attacks men in different manners, some are slightly ill, complaining for several days of a head-ache, like that produced by the vapours of charcoal, sometimes stronger, at others weaker, occasionally ceasing altogether, and then returning, *&c.*"

The following summer the pestilence entered Poland, and made great havoc there; from thence it was brought to Kiow, where it carried off 4,000 persons. All commerce was at first interrupted between that city and Moscow, guards were placed on the great roads, and a quarantine of some weeks established for those who wished to pass.

Towards the end of November, 1770, the anatomical dissector of the military hospital of Moscow, was attacked with a putrid fever accompanied with petechiæ, which carried him off the third day. The attendants on the sick, of the same hospital, with their families, occupied two rooms, separated from the other. In one of these chambers, all, to the number of eleven, including their wives, fell sick of a putrid acute disease,

accompanied by petechiæ, in some of whom buboes and carbuncles were observable; the greater part died between the third and the fifth day. The same malady reached also the attendants on the sick who occupied the adjoining room.

On the 22d of December, a medical board was summoned, the chief physician of the military hospital made the report which I have just stated, three other physicians corroborated the truth of it, and all affirmed that fifteen persons, consisting of attendants on the sick, with their wives and children, had died of the disease since the end of November; that five were still ill, but that the malady had not as yet declared itself in any other part of the hospital. Of the eleven doctors assembled, no one hesitated to call the disease the plague, except the physician of the city, who, having been called several times by M. Schafonsky to visit these patients, had declared that it was a simple putrid fever, an opinion he still maintained.

The military hospital is situated out of the town, near the suburbs of the Germans, from which it is separated by a little river, called Yausa; our advice was to shut it up immediately, and to surround it with soldiers, who should prevent all communication; and we further required, that all the attendants on the sick, together with their families, should be removed, carefully separating the sick from those who were well; and that the clothes and furniture, as well of those who were still living, as of the dead, should be burnt. The cold began late this year, the season was wet and rainy to the end of December, when there came on a sharp frost which lasted the remainder of the winter. Besides the report we made in common, M. the Field Mareschal Count of Soltikoff, requested of me my own private opinion, and intimated his wish that I should mark down what I thought ought to be done in these circumstances.

I did not hesitate to give my opinion in a clear and decided manner, during a period of such great public danger. In consequence I sent a memorial* to the governor general, in which I

* The most important passage of the memorial, transmitted by Dr. Mertens to the governor general, is the following :—

insisted principally on the necessity of taking all the precautions possible with respect to the hospital, where I asserted that the plague existed among the attendants on the sick *(les infirmiers.)* I added that it was necessary to make the most exact inquiries, to ascertain if the plague existed any where concealed in the city, and that wherever it might be detected it should be stopped in the same manner. For this purpose it was necessary to desire the physicians and surgeons, if they should meet with any thing extraordinary or suspicious among their patients, immediately to make a report of it to the medical board; and to enjoin the officers and superintendents of the police, to call in the physicians as soon as many persons should fall ill in the same house. I declared nevertheless that the attempt would be very difficult, if there were other parts of the city infected; but I said that, even in that case, it might still be hoped that the great cold would extinguish these sparks of pestilence, provided the proper measures were immediately adopted.

We had wished to have kept all this affair concealed from the Public; but the news of the plague which had afflicted Kiow some months before had so disposed their minds, that the precautions adopted with respect to the military hospital, occasioned a panic terror throughout the city. It was in vain we endeavoured to inspire the inhabitants with confidence. But some days after, when they learned that there were only seven attendants in the hospital attacked by the disease, and that all the rest were free, they fell into the opposite extreme, and, believing themselves in perfect safety, the great, the nobles, the merchants, and the common people, in short, all the inhabitants, with the exception

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" The plague is a disease which is only communicated by the immediate touching of the persons, the clothes, or the furniture, of those affected with the plague. It is not diffused in the air, although the different states of the atmosphere may more or less dispose our bodies to receive the infection. This opinion being established, my advice, as well as that of the other physicians, is, that in the present circumstances, the large hospital should be surrounded by soldiers, who should allow no person to enter or go out, and who should intercept all communication with the rest of the city."

of the governor and a small number of persons, would no longer listen to the use of any precautions. This security, supported chiefly by the opinion of the physician of the city, continued till the month of March, and there was no longer any talk of a meeting of the faculty. Every precaution was, in spite of whatever we could say, neglected in the city; it was only at the military hospital, and at the express command of her imperial majesty, gloriously reigning, that they were observed; in consequence of which, the plague, after having attacked twenty-four attendants, two of whom recovered, was extinguished in that establishment. Six weeks after the death of the last, all the effects, clothes, beds, *&c.*, which they had used, were burned, together with the wooden house which they had occupied. The hospital was re-opened at the end of February.

The vulgar, which only judges of things by their results, calls every malady a plague which carries off many thousand people, and will never believe that it exists unless a great number of deaths happen to confirm it. Besides, a great number of persons have taken it into their heads, I know not upon what reason, that the plague is a scourge from heaven, which suddenly kills legions of people. We find in almost all the histories of the plague that this prejudice has always been the principal cause that has prevented the use of the means necessary to stop the disease in the beginning; at which period the malady may be compared to a spark easy to be extinguished, but if neglected, capable of exciting a conflagration that nothing can arrest.

As it generally happens, the opinion that flattered the public security prevailed pretty generally, and the only satisfaction we enjoyed arose from the conscientious approbation of having acted the part of prudent physicians and good citizens. Would to God that matters had rested there, and that the event had not confirmed the truth of the opinions we had advanced! We should not then have seen the frightful destruction of so many of our fellow-creatures, nor have been witnesses of the most horrible public calamity.

On the 11th of March, 1771, a medical board was again assembled. There was in the centre of the city a large house,

situated near the river, which was used in the manufactory of cloth for the army. Three thousand persons, of both sexes, were employed in it, the third part of whom, who were of the lowest class, lived on the ground floor; the others, after having worked there during the day, returned home in the evening to different quarters of the town. M. Yagelsky, at that time second physician of the military hospital, whom the governor-general had sent in the morning to the manufactory, told us that he had found there some sick (eight in number, if I am not mistaken) ill of the same disease, which he had seen three months before among the attendants of the military hospital, and covered with petechiæ, vibices, carbuncles and buboes. He related also that he had seen eight dead bodies having the same marks. When he interrogated the workmen of the manufactory, as to how and when the disease had first shewn itself, they confessed to him that at the beginning of January, a woman, who had a tumour on her cheek, had sought shelter with a relation who lived there, and that she had died in his apartment, and that since that time some one amongst them had been daily attacked by the disease. They acknowledged moreover that, since that period up to the day in question, one hundred and seventeen persons had died, including the seven dead bodies which were still unburied. This report of M. Yagelsky was corroborated by two other physicians, who had also been sent to the manufactory for the purpose of examining the sick and the dead bodies.

We now declared again, in a memorial addressed to the governor-general and to the senate, (who had assembled us,) that the malady was the plague, and we recommended that all the inhabitants of this house should be ordered to quit the town, taking care to separate the sick from the healthy; that the effects of the dead, as well as of those who were ill, should be burnt; and that the most rigid investigation should be set on foot to ascertain if no germ of the plague existed concealed in some other corner of the city.

Terror again took possession of the minds of every one; the consequence of neglecting the precautions we had advised became

but too apparent. Of the thirteen* medical men who met, two, who, three months before, had agreed to give along with us the name of plague to the disease of the attendants on the military hospital, now said that this malady was not of that nature, but a putrid fever; and they designated it as such in the report that they separately made to the senate.

These two physicians, who, together with the greatest part of the surgeons, were now of an opinion contrary to ours, were led into this error, by seeing that the number of the dead in the city was not increased, but rather less than on preceding years, and that there were few people sick. Some days afterwards, having been sent for to the senate, with the other physicians and surgeons, in order that each of us might openly declare his opinion, I took God to witness, that I was persuaded that the disease under consideration was really the plague; ten of my colleagues were of the same opinion; the two above-mentioned differed with us, but acknowledged, at the same time, that the precautions against the evil ought not to be neglected, which, though not the plague, had still something contagious in its character.

The 11th of March was occupied in deliberations; the infected house was shut up, guards were posted, so that no one should enter or quit it: many of the persons thus confined escaped out of the windows, the remainder were transported, during the night, out of the city, the healthy to the convent of St. Simon, and the sick to that of St. Nicholas, the first at the distance of six versts, the other at that of eight versts. These monasteries are surrounded by high walls, and have only one access. As the plague had carried off some of the work-people belonging to the manufactory, who occupied their own houses, another convent was selected for them, equally situated out of the town. The surgeons, who had the care of all these establishments, were ordered to send daily reports to the medical officer, of the number of sick and deaths. Physicians were appointed to see that

* The physician of the town (an anti-contagionist) was afflicted with a gangrenous ulcer on the leg towards the end of February, which prevented his attending the meeting; he died a short time afterwards.

every thing concerning the treatment of the patients, the care of those who were in quarantine, and the burial of the dead, was exactly observed.

The physicians, Erasmus and Yagelsky, deserved well of the Public, in the performance of these several services. When any one of those who were in quarantine fell sick, he was kept apart in a room, until he exhibited symptoms of the plague, when he was removed in a carriage, by persons destined for that office, to the plague-hospital, the convent of St. Nicholas. The public baths, which the people usually frequent at least once a week, were shut. The town was divided into seven quarters, to each of which a physician, with two surgeons was appointed, in order that all the sick, as well as the dead bodies, should be examined; officers of the police were attached to them. Interments in the city were prohibited, and convenient burial-places were assigned, on different sides, at some distance from the town. It was decreed, that if any one of the common people should be attacked by the plague, he should be carried to the hospital of St. Nicholas, and, after having burned his effects, those persons who had occupied the same room with the infected, should be confined in public places out of the town during forty days. If a like occurrence happened in the house of a tradesman, or of a noble, all the servants who had lived in the same apartment with the sick person, should also be kept in similar quarantine; and the master, with all his family, should remain confined to his own house for eleven days. This resolution was confirmed by the senate, and sanctioned as a law. General Peter Demitrewisch de Yeropkin, distinguished as well by his manners and social virtues as by birth and valour, was nominated, by his Imperial Majesty, Director-General of Health.

There were not many people who were even yet convinced that the plague had reached Moscow. M. Orreus, an army physician, (who had, of his own accord, taken upon himself the treatment of those afflicted with the plague at Yassy) passing through Moscow on his way to Petersburgh, was requested to visit the sick, and examine the dead bodies I have mentioned above; and having done so, he affirmed that the disease completely resembled that, which, a short time before, had made such

havoc in Moldavia and Wallachia, and that it was really the plague. This opinion was also confirmed by Dr. Lœrch, just returned from Kiow, where he had remained since the preceding year, during the period of the plague in that city.

The season continued cold to the middle of April, which was the cause that the miasma remained more fixed and inactive, and attacked those only who lived with the infected. In the plague-hospital, three or four only died daily; and of the workmen who had been placed in quarantine, about the same number only fell sick. According to the reports of the physicians, of the surgeons who had the inspection of the different quarters of the town, and of the police officers, the city seemed healthy. Almost every body believed that the physicians who had called the disease the plague, had propagated an idle story; others entertained great doubts on the subject. Matters remained in this state until the middle of June, during which interval about two hundred had died in the hospital of St. Nicholas. The number of sick and dead in that establishment continued to decrease daily, so that during an entire week, though the season was very hot, not a single person fell ill of the plague, and there remained in the hospital a few convalescents only: in the city itself, not a single vestige of the plague was to be found. As among the work-people of the manufactory, who regularly lived in the city, but who had been removed to a monastery to perform a quarantine, no one, for the space of two months, had been attacked with the plague, they were permitted to return to their own homes. We began now to hope, that the plague had been entirely stifled by the precautions that had been adopted. But we had scarcely begun to enjoy this cheerful prospect, when, towards the end of June, some persons were seized with the same disease in the Hospital St. Simon, where the quarantine had been established. In a house in the suburb Préobraginsky, on the 2d of July, six persons died* in the

* It was not possible to discover whence they had caught the infection; perhaps, from the negligence of the sentinels, they had had some communication with the people in quarantine; or they might have dug up the property which the former had concealed under ground, previous to being shut up.

course of the night, and a seventh, who had been an inmate with them, made his escape: livid spots, buboes, and carbuncles, were found on the dead bodies. The following days, many persons were found ill among the people in various quarters of the town; and the mortality increased to such a point, that the number of deaths, which usually had been from ten to fifteen daily, and which, even in seasons of epidemical putrid fevers, as during the preceding years, did not exceed thirty, amounted, towards the end of July, to two hundred in twenty-four hours. On the bodies of the sick, as well as on the dead, were found large livid spots; some had carbuncles and buboes: others died suddenly, or in the space of twenty-four hours, before the buboes and carbuncles could come out, but the greater number died on the third or fourth day. By the middle of August, the number of deaths amounted daily to four hundred, and by the end of the same month to six hundred, (at this period more buboes and carbuncles were observable than during the month of July). At the commencement of September, seven hundred deaths occurred daily; and, in a few days, this number increased to eight hundred, and shortly afterwards reached a thousand. The contagion spread still more during the time of the revolt, which began on the evening of the 15th September, when the infuriated populace opened the hospitals and places of quarantine, re-established the ecclesiastical ceremonies* relating to the sick, in use amongst them, and began again to bury the dead in the city.

The people resumed their old custom of kissing the dead body, and would not adopt any further precaution, saying that they were useless, and that this public calamity was nothing but (I employ their own expressions,) a scourge from God, as a punishment for this neglect of their ancient religious worship. They added, that those who were to die were already predestined; and that they could not therefore avoid their fate; that all precautions were a burthen to themselves, and odious to the Divinity, whose anger could alone be appeased by abandoning all human means of re-

* Besides the ordinary prayers, it is a custom in Russia, to carry, in great pomp, to the sick, images of saints, which every body, one after the other, kisses.

lief*. General Yeropkin, with a handful of men collected at the moment, re-established, in a few days, the public tranquillity, and placed every thing on its former footing; but the concourse of so many persons in health with those who were diseased, increased the contagion to such a degree, that 1,200, or even more, died daily.

Moscow, one of the greatest cities of Europe, contains four enclosures, one within the other; the smallest, which occupies the centre, called the Kremlin, and the second, that surrounds it, called the Kitaya (or Chinese city,) are surrounded by brick walls, and enclose houses constructed of the same materials; the third, Bielogorod (or White city,) is without walls because they have been thrown down; and the fourth, Zemlanoigorod (so named from Zemla, earth, and gorod, city,) is fortified on the outside by a ditch, guarded by an earthen parapet; in these two last quarters the greater number of the houses are of wood. These houses are not contiguous, but a little distant from one another, and each of them is generally occupied by a single family; so that they have, at the most, one or two stories, including the ground floor. The nobles have a numerous establishment of servants. The people dwell in great numbers, and very much crowded, in small houses of wood.

In the winter, the nobles resort from all parts of the empire to the capital, bringing with them a great number of servants. Many of the lower orders of the people, who have been employed in the labours of agriculture, retire during the winter into the town, to gain a livelihood by different trades. This concourse of people

* The populace, in its frenzy, wished to take vengeance for the evils it suffered, on the persons of those who were labouring for its preservation: after having sacrificed one victim to its blind fury, they turned against the physicians and surgeons. Some persons, of the very dregs of the people, pillaged my house, breaking every thing they found there; they sought also the other physicians and surgeons, and pursued those whom they could meet. Providence protected us all from their hands. For my own part, I had taken up my residence four days before (suspecting nothing of all this disturbance,) by order of the council, in the Foundling Hospital, that I might better take measures for the preservation of that establishment.

fills the city to such a degree, from the month of December to March, that the population during that season amounts, according to some, to 250,000 persons, and according to others to 300,000. In the month of March the inhabitants begin by degrees to return to the country, so that during the summer their number is diminished by one-fourth. In 1771, the fear of the plague had made so many more fly away, that I do not believe, that during the month of August, there were more than 150,000 in the city. An idea may be formed of the violence of the malady, and of the activity of the poison, from the consideration that of these 150,000 inhabitants, 1,200 were carried off daily. The deaths remained fixed at that number for some days; afterwards they diminished to one thousand, The populace having, during the revolt, re-established all the ecclesiastical ceremonies in use among them at the burial of the dead, almost all the priests, deacons, and other ministers of the altar perished at that time of the plague. This same mob being brought back to a sense of duty by severity, and become more tractable at the sight of the increasing public calamity, began to implore our aid. The monasteries, and other plague-hospitals, were crowded, and the contagion had spread every where, so that no sick person was compelled to go thither; besides, the city itself was so full of pestiferous persons, that it might well be called a great hospital. We were obliged, therefore, to rest satisfied with exhorting every one to take care of himself, conjuring all who were healthy to avoid, as far as possible, touching any sick person with uncovered hands; to burn the clothes, and every thing that had been used by those who had been attacked by the plague, and to keep up a pure and free circulation of air in their apartments.

Count Gregory Orlow (now a prince of the Holy Roman Empire) arrived at this time at Moscow, furnished with full powers from the Empress. I received an order, in common with the other physicians, to give separately my opinions in writing; each of us was particularly enjoined, to dwell chiefly on the means we thought necessary to be employed to destroy the contagion. Having established the public tranquillity, he selected from these different memorials what he found the most advisable, and made the best ar-

rangements, as well for the treatment of the sick, as for the preservation of the healthy. He caused also new hospitals to be established for the reception of the poor who might be attacked with the plague. For some months before, the plague had been already carried into many villages, both near and distant from the capital, and persons who had escaped from Moscow, had introduced it into Kalomna, Yaroslaw, and Tula. Inspectors of health were sent, together with physicians and surgeons, to the assistance of these towns and villages. A tribunal of health was formed, composed of General Yeropkin, as president, of some counsellors, of three physicians, and of one surgeon. This council received daily the reports of the physicians, and of the police officers; and every thing which regarded the public health belonged to their department. Two physicians, M. Pogaretzky, and Meltzer, induced by the promise of a reward of 1,000 roubles, took charge each of a plague hospital, and fixed their residences there.

I observed the first frost on the 10th of October; from that day the disease became a little less violent, and the pestilential virus more fixed. The number of sick and of deaths insensibly diminished, and the course of the disease, which hitherto had been of one, two, or three days, extended itself to five days. Neither so many large lenticular petechiæ and other spots, nor so many carbuncles were met with; but glandular swellings were found upon most of the sick. *The great cold which reigned during the two last months of the year, weakened so much the violence of the pestilential miasma, that those who attended upon the sick, or buried the dead, were less easily caught by the contagion, and felt the effects of it more slowly; and many of the sick were only slightly affected, and walked about, notwithstanding they had glandular affections.

The end of the year 1771 terminated, thanks to Heaven, this cruel scourge, as well in Moscow as in all the rest of the Russian empire. Besides the three towns named above, there were more than 400 villages infected. The season was very cold during the whole winter. In order to destroy all the germs of the pestilential leaven,

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* The thermometer of Reaumur, indicated in the mornings a degree of cold corresponding to from 16° to 22°.

the doors and windows of the rooms, where the sick had been, were broken; these places were fumigated with an antipestilential powder; and the old houses of wood, were entirely demolished. Traces of the plague were met with in all parts of the city.

In the month of February, 1772, more than 400 dead bodies were discovered, which had been interred during the preceding year, in the houses. There is a virtue in cold*, so efficacious in destroying contagion, that none of those who dug up these bodies, and carried them to the public cemeteries, fell sick. The total number of those who died of the plague, amounted, according to the reports made to the senate, and to the council of health, to more than 70,000 persons; of these more than 22,000 died during the month of September only. If we add to these, those who had been buried in secret by individuals†, the whole will amount readily to 80,000, to which it will be necessary to annex the number of those in 400 villages, and in the three towns of Tula, Yaroslaw, and Kalomna: from which it follows, that this plague had carried off more than 100,000 persons.

Persons, condemned to death, or to the public works, were employed at first in removing and burying the dead; when these were not sufficient, poor persons were engaged for a sum of money for this service; a cloak, gloves, and a mask made of oil-skin, were given to each, and they were especially enjoined not to touch a dead body with uncovered hands. They refused to obey us, it appearing impossible to them that one could fall ill by the simple

* Dr. Poparetsky, who took charge in the month of October, of the sick at the hospital Laferte, told me some time after, that some of the persons employed in carrying the dead, clothed themselves in sheep skins, which had been used by the sick, after they had been exposed, during the month of December, to the intense cold, for the space of forty-eight hours, and that none of them caught the plague in consequence.

† The number of these was not few, for at the height of the plague, men, horses and cars, employed in carrying away the dead bodies, were not enough by a great deal. There were then some who remained two or three days without burial; relations, friends, or poor people engaged for a sum of money, carried them away; all of these could not consequently be noticed, no more than a number of others, who were interred secretly, and of whom no mention was made in the reports sent to the senate.

touching of the dead bodies, or of their garments, and they attributed the effects of the contagion rather to an inevitable fatality. We lost many thousands of these people, who rarely remained well beyond a week; I learned from the inspectors of health, that the greater number fell sick on the fourth or fifth day.

The plague, as it generally happens, oppressed only the lower orders; among the nobles and merchants in easy circumstances, if a few were excepted, who were the victims of their temerity and of their negligence, scarcely any one was attacked. The disease was communicated only by touching the sick, or things infected by them; the atmosphere did not spread the contagion in any manner, but remained during the whole time perfectly healthy. When we visited the sick, we approached them so near that often there was only the interval of a foot between us; and without using any other precaution than that of neither touching their bodies, their clothes, nor their beds, we remained free from the plague. When looking at the tongues of the sick, I was in the habit of holding before my mouth and nose a handkerchief wet with vinegar. Among so many deaths, I only know of three noblemen who were attacked by the disease, very few respectable tradesmen, and only 300 strangers of the lowest condition; all the rest were Russians of the inferior class. The first bought only, during this period of calamity, what was absolutely necessary for their subsistence; but the others purchased every thing which was saved from the flames, and which was sold at a low price, refusing also to burn the effects which fell to them by inheritance, and carrying off clandestinely many things. Notwithstanding whatever we could say or do, nothing availed.

In the city there died of the plague two surgeons, and a number of assistant-surgeons in the hospitals. Dr. Pogaretzky and M. Samoïlowitz, first surgeon of the hospital St. Nicolas, had both of them many times the plague, of which they were cured by critical sweats, which they had at the beginning of the disease. The Imperial Foundling Hospital, which contained nearly a thousand children, and four hundred adults, consisting of nurses, master, and journeymen workmen, was preserved by the precautions which I shall describe afterwards. There were only four work-

men, and as many soldiers, who, having got over the inclosure during the night, were attacked at different times, but by keeping them separate from the rest of the house, the disease did not spread farther. Thus this whole house remained healthy, though all those around it were ravaged by the plague. It follows, therefore, that the atmosphere, as well during the greatest heats of summer, as during the cold season*, communicated the contagion in no manner whatever; it was propagated only by the contact of the sick, and of substances infected by them.

The plague attacked the young and the robust much more easily than the old and the feeble; pregnant women and nurses were not exempt from it. It appeared to me that children below four years caught it with more difficulty, but that, when once infected, they had the worst symptoms.

Though, amongst some, there was no marked fever observable, almost all those, however, who were sick of the plague, had more or less fever.

There were some, though few, to speak the truth, who, from the very beginning, passed from delirium into a phrenzy, accompanied by a violent fever, but the greater part were weak, and complained only of anxiety and head-aches.

This history of the plague will appear, perhaps, too long to many persons, but, I am persuaded, that it will be infinitely more easy to discover the nature of the disease, to ascertain the manner in which it spreads, and to point out the proper methods of cure and preservation, from the simple recital of its origin and of its progress, and from the description of its symptoms and other circumstances, than from all the reasonings and dissertations which are to be found in the voluminous works written on this subject.

The physician of the military hospital endeavoured to ascertain, how and in what manner the plague was brought there, and

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* It is astonishing that it is towards the summer solstice, according to Russel (vide Natural History of Aleppo,) and Prosper Alpinus (de Medicina Ægyptiorum,) that the plague usually ceases in Asia and Africa, while in Europe it is at that time that it chiefly rages, being destroyed by the cold of winter.

found, at last, that two soldiers had died there in the month of November, 1770, a little after their arrival from Chocsim, where the plague existed at that period; and that a colonel, whom they had followed, had died on the road. The anatomical dissector opened, perhaps, the bodies of these two people, and if it was the plague which carried them off, it was from them that he caught it.

It is probable that the attendants on the sick were infected by frequently touching these two soldiers during their lives, or rather by touching their clothes or dead bodies: they afterwards spread the contagion among their families.

The following is an account of the means employed by Dr. Mertens, to prevent the introduction of the plague into the Imperial Foundling Hospital, of which he had the medical superintendence.

This hotel, says he, is situated in the middle of the city, at the confluence of the Yausa and the Moscua. It occupies a space, the circumference of which, (guarded at that time only by an inclosure six feet in height), may be estimated at one-third of a German mile, (about a mile and a half.) The edifice is capable of containing easily 5,000 children. The part of the building which was already completed, in 1769, was inhabited by 1,000 children and 300 adults; the rest of the establishment, consisting of masters, valets, workmen, and soldiers, to the number of about 100, lived in wooden houses, contiguous to the stone edifice, and comprehended also within the inclosure, which had three gates. In the month of July, as soon as I perceived that the plague was spreading in the city, I requested the council of the hospital to order the gates to be shut, with the exception of that where the porter was placed, and that no one should be allowed to enter or go out, without the permission of the chief inspector. I recommended also that a great stock of flour, cloth, linen, shoes, and many other necessaries, should be laid in from places which were still healthy. During the month of August, when the plague raged with great fury, no one was permitted to enter except myself. There were persons in the pay

of the house, living without its inclosure, who brought every thing necessary for subsistence, and carried letters. I gave an order, in writing, to the porter, in which was expressed every thing that he might allow to enter, and with what precautions. The butcher threw the meat into great buckets full of vinegar, out of which the assistant housekeeper took them. I did not allow any furs, wool, feathers, cotton, hemp, paper, linen, or silks, to enter: sugar-loaves were taken in, when the paper and string round them had been removed.

All letters were pierced with a needle, and, after being soaked in vinegar, dried by the smoke of juniper-wood. All those who lived within were permitted to speak with their relations and friends, who stood at a certain distance on the outside of the gate. We were obliged to buy, in the month of October, 200 pairs of boots and shoes; I ordered them to be kept some hours in vinegar, and afterwards dried.

I visited all the sick in the house twice a day; two surgeons examined the others morning and evening, and informed me when they found any of them unwell. When any thing appeared to me suspicious about a patient, I kept him apart from the others until I was sure that it was not the plague. In this way I happened to discover the existence of the plague seven times among the soldiers*, and the workmen of the foundling hospital; but as I separated them at the first appearance of the disease, none of them infected the others, except the master chimney-sweeper, who gave it to his apprentice. From the month of July we ceased to admit any more children, or women to lie-in, having proposed to the council to hire in the mean time a house for that purpose in the suburbs; a proposal, however, which was not adopted before the month of October, at which time there still died in the city more than a thousand persons daily. In this house of quarantine, the children who were brought were stripped quite naked, their clothes were burnt, and, after having well washed their bodies with vinegar and water, other dresses were given them.

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* The guard consisted of twenty-two men and an inferior officer; and from the month of July I had obtained an order that it should not be changed.

I kept the childien for the space of fifteen days in three rooms separated from the others; and at the expiration of this time, if no symptom of plague manifested itself among them, they were placed, each as soon as he had finished this first period of probation, in the chief building of this quarantine establishment, where they remained fifteen days more before they were conveyed to the great hotel*. I visited these children and the women who were lying-in every day. One child was brought with a pestilential bubo, and two others during the time of probation had the plague, accompanied with glandular affections; they were removed to separate rooms with their attendants, and thus the plague did not spread any farther.

I had thus the happiness to snatch from death about one hundred and fifty children, brought to the quarantine since the month of October. In the spring of the year 1772 every thing was put on its former footing.

Besides the above historical account of the plague at Moscow, there are three other chapters contained in the memoir of Dr. Mertens, which relate to the symptoms of the disease, its mode of treatment, and the precautions necessary to be employed to prevent its propagation.

As to the contagious nature of the disease, and the usual means by which it spreads, committing dreadful ravages among the

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* In the Lazaretto at Marseilles the following is the system adopted, resembling in many respects, particularly as to time, the plan followed by Dr. Mertens. On the arrival of a person from the Levant, who has to perform a quarantine of thirty days, a guard is appointed him, whose business it is to sleep in the same apartment, and never to lose sight for a moment of his charge. On the day of his entry, as soon as he has taken possession of his room, his trunks are unpacked, and his clothes and himself submitted to a most disagreeable, half suffocating, fumigation of muriatic acid gas (procured by pouring oil of vitriol on common sea-salt.) For the next fifteen days he is kept *en serein*, as it is called; that is, a close prisoner in his apartment. The fumigation is again repeated; and he is now for the next fifteen days permitted to enjoy the luxury of walking about the inclosures of the Lazaretto, always however attended by his guard, to see that he touches no one. On the 29th evening he is again fumigated, and early on the following morning his quarantine is finished.—*(By the Editor.)*

lower orders of the people, while the rich and the prudent are in a great measure exempt from its attacks, the opinion of the author, as expressed in his own words, in the original Memoir, is as follows:

"Dans la peste ceux qui s'abstiennent de communication quelconque avec les malades, tant immédiate, que par diverses substances qui contiennent le venin, en restent exempts, quoiqu'ils vivent dans un pays ou dans une ville où elle fait des ravages; tandis que les pauvres, obligés de gagner leur vie par le travail, et moins inquiets de leur conservation, n'évitant pas le commerce des malades, se couvrant de vêtemens qu'ils achetent à vil prix, ou qu'ils héritent, et ainsi continuellement exposés à la contagion, sont principalement attaqués de ce mal. Si la cause de la peste étoit dans l'atmosphère, ou qu'elle y fût portée çà et là dans son état d'activité, il s'ensuivroit, au contraire de ce qui arrive, que tous les habitans du même pays, au moins du même lieu, de quelque condition qu'ils soient, en devroient être attaqués indifféremment, comme on l'observe dans plusieurs maladies épidémiques. La seule chose qu'on puisse, quant à la peste, attribuer à l'atmosphère, est que ses différentes températures peuvent plus ou moins disposer nos corps à recevoir la contagion, qu'elles peuvent augmenter la violence du miasme, l'émousser ou le détruire."—p. 58, 59.

In confirmation of this opinion, he quotes the fact, that in the years 1718 and 1719, when the plague committed such havoc at Aleppo, as to carry off in six months no fewer than eighty thousand persons, the English families who formed the factory of that city, and who had shut themselves up in their houses, remained healthy: he concludes, that a free and unconfined atmosphere does not convey the contagion, though the air, pent up in a close room, and loaded with the exhalations of many persons labouring under the pestilential disease, may infect the healthy. There is nothing remarkable in the remedies he mentions as having been employed; they were all very inefficacious, and he observes, that the rapidity with which the disease hastened to a fatal termination, frequently prevented the use of any medicines.

In the Chapter which treats of the precautions to be employed

against the plague, he laments the fate of medical men; who, in giving their opinion on the nature of the disease, have to contend against the prejudices of their fellow-citizens; and, particularly, to encounter the abuse of merchants, and other persons greedy of profit, who usually deny that the disease is the plague, until it has caused the death of many thousand persons. In the beginning of the malady, if its nature is only as yet suspected, and scruples remain in the minds of the magistrates, he coolly advises them to put the matter beyond doubt, by shutting up some wretches who are under sentence of death with the sick, and making them wear their clothes, in order to see if it be actually contagious.

Art. XVIII. *Report on the State of the Manuscripts of Papyrus, found at Herculaneum. By Sir* Humphry Davy, *Bart. F.R.S.*

Having witnessed Dr. Sichler's attempts to unroll some of the Herculaneum MSS., it occurred to me that a chemical examination of the nature of the MSS., and of the changes that they had undergone, might offer some data as to the best methods to be attempted for separating the leaves from each other, and rendering the characters legible. On mentioning this to Sir Thomas Tyrwhitt, he obligingly put into my hands fragments of MSS, which had been operated on by Mr. Hayter and Dr. Sichler, and I received from Dr. Young some small pieces of a MSS. which he himself had formerly attempted to unroll.

My experiments soon convinced me that the nature of these MSS. had been generally misunderstood; that they had not, as is usually supposed, been carbonized by the operation of fire, and that they were in a state analogous to peat, or Bovey coal, the leaves being generally cemented into one mass by a peculiar substance which had formed during the fermentation and chemical change of the vegetable matter composing them, in a long course of ages. The nature of this substance being known, the destruction of it became a subject of obvious chemical investigation; and I was fortunate enough to find means of accomplishing this without injuring the characters or destroying the texture of the MSS.

After the chemical operation, the leaves of most of the fragments perfectly separated from each other, and the Greek characters were in a high degree distinct; but two fragments were found in peculiar states; the leaves of one easily separated, but the characters were found wholly defaced on the exterior folds, and partially defaced on the interior. In the other, the characters were legible on such leaves as separated, but an earthy matter, or a species of tufa, prevented the separation in some of the parts; and both these circumstances were clearly the results of agencies to which the MSS. had been exposed, during or after the volcanic eruption by which they had been covered.

It appeared probable from these facts, that different MSS. might be in other states, and that one process might not apply to all of them; but even a partial success was a step gained; and my results made me anxious to examine in detail the numerous specimens preserved in the museum at Naples. Having had the honour of shewing some of my results to the Prince Regent, His Royal Highness was graciously pleased to express his desire that I should proceed in my undertaking; and I found, on my arrival at Naples, that a letter from His Royal Highness to the King, and a communication made from the Right Hon. the Secretary of State for Foreign Affairs to the Neapolitan government had prepared the way for my inquiries, and procured for me the necessary result of such patronage, every possible facility in the pursuit of my objects.

In this report I shall first consider the circumstances under which the MSS. have been buried, and the agencies to which they have been exposed; from which it will be easy to account for the state in which they are found. This state I shall next describe, and consider the means which have hitherto been employed for unrolling them, and the assistance which chemical processes seem to afford to the undertaking; and I shall, lastly, offer some suggestions as to the nature of the works which may be expected to be found amongst these imperfect and mutilated remains of ancient literature.

An examination of the excavations that still remain open at Herculaneum immediately confirmed the opinion which I enter-

tained, that the MSS. had not been acted on by fire. These excavations are in a loose tufa, composed of volcanic ashes, sand, and fragments of lava, imperfectly cemented by ferruginous and calcareous matter. The theatre, and the buildings in the neighbourhood, are encased in this tufa, and, from the manner in which it is deposited in the galleries of the houses, there can be little doubt that it was the result of torrents laden with sand and volcanic matter, and descending at the same time with showers of ashes and stone still more copious than those that covered Pompeii. The excavation in the house in which the MSS. were found, as I was informed by Monsig. Rosini, has been filled up; but a building, which is said by the guides to be this house, and which, as is evident from the engraved plan, must have been close to it, and part of the same chain of buildings, offered me the most decided proofs that the parts nearest the surface, and, *à fortiori*, those more remote, had never been exposed to any considerable degree of heat. I found a small fragment of the ceiling of one of the rooms, containing lines of gold leaf and vermilion in an unaltered state; which could not have happened if they had been acted upon by any temperature sufficient to convert vegetable matter into charcoal.

The state of the MSS. exactly coincides with this view; they were probably on shelves of wood, which were broken down when the roofs of the houses yielded to the weight of the superincumbent mass; hence many of them were crushed and folded in a moist state, and the leaves of some pressed together in a perpendicular direction, and all of them mixed in two confused heaps; in these heaps the exterior MSS. and the exterior parts of the MSS. must have been acted on by water; and as the antient ink was composed of finely-divided charcoal suspended in a solution of glue or gum, wherever the water percolated continuously, the characters were more or less erased.

Moisture, by its action upon vegetable matter, produces decomposition, which may be seen in peat bogs in all its different stages; when air and water act conjointly on leaves or small vegetable fibres, they soon become brown, then black, and by long continued operation of air, even at common temperatures, the charcoal itself is destroyed, and nothing remains but the earths which entered

into the constitution of the vegetable substance. When vegetable matter is not exposed to moisture or air, its decay is much slower; but in the course of ages its elements gradually re-act on each other, the volatile principles separate, and the carbonaceous matter remains.

Of the MSS. the greater number, those which probably were least exposed to moisture or air, (for till the tufa consolidated air must have penetrated through it,) are brown, and still contain some of their volatile substance, or extractive matter, which occasions the coherence of the leaves; others are almost entirely converted into charcoal, and in these when their form is adapted to the purpose, the layers may be readily separated from each other by mechanical means. Of a few, particularly the superficial parts, and which probably were most exposed to air and water, little remains except the earthy basis, the charcoal of the characters, and some of that of the vegetable matter, being destroyed, and they are in a condition approaching to that of the MSS. found at Pompeii, where the air, constantly penetrating through the loose ashes, there being no barrier against it as in the consolidated tufa of Herculaneum, has entirely destroyed all the carbonaceous parts of the Papyrus, and left nothing but earthy matter. Four or five specimens that I examined were heavy and dense, like the fragment to which I referred in the introduction to this report, a considerable quantity of foreign earthy matter being found between the leaves and amongst the pores of the carbonaceous substance of the MSS., evidently deposited during the operation of the cause which consolidated the tufa.

The number of MSS., and of fragments originally brought to the museum, as I was informed by M. Ant. Scotti, amounted to 1,696; of these 88 have been unrolled, and found in a legible state; 319 more have been operated upon, and, more or less, unrolled, and found not to be legible; 24 have been presented to foreign potentates.

Amongst the 1,265 that remain, and which I have examined with attention, by far the greatest number consists of small fragments, or of mutilated or crushed MSS., in which the folds are so irregular as to offer little hopes of separating them so as to

form connected leaves; from 80 to 120 are in a state which present a great probability of success, and of these the greater number are of the kind in which some volatile vegetable matter remains, and to which the chemical process, referred to in the beginning of this report, may be applied with the greatest hopes of useful results.

One method only has been adopted in the museum at Naples for unrolling the MSS., that invented in the middle of the last century; it is extremely simple, and consists in attaching small pieces of gold-beater's skin to the exterior of the MSS., by means of a solution of isinglass, suffering the solution to dry, and then raising, by means of thread moved by wooden screws, the gold-beater's skin, and the layer adhering to it from the body of the MS.; this method of unrolling has the advantage of being extremely safe,—but it is, likewise, very slow, three or four days being required to develop a single column of a MS. It applies, likewise, only to such MSS. as have no adhesive matter between the leaves; and it has almost entirely failed in its application to the class of MSS. which are found to have Roman characters, and where the texture of the leaf is much thicker. It requires, likewise, a certain regularity of surface in the MSS.

The persons charged with the business of unrolling the MSS. in the museum, informed me that many chemical experiments had been performed upon the MSS. at different times, which assisted the separation of the leaves, but always destroyed the characters. To prove that this was not the case with my method, I made two experiments before them, one on a brown fragment of a Greek MS., and the other on a similar fragment of a Latin MS., in which the leaves were closely adherent; in both instances the separation of the layers was complete, and the characters appeared to the persons who examined them more perfect than before.

I did not think it proper to communicate the details of my method to the operators in the museum; for though it possesses great simplicity, yet it must be performed with care, and is a gradual process, and might be injurious in unskilful hands, and ought to be executed by an accurate manipulator, and one acquainted with the science of chemistry. My only motive for

deferring the publication of it has been the hope of rendering it subservient in a secure way, and upon an extensive scale, to an undertaking which, without some such method, seemed a bequest to posterity or to future ages.

I brought with me to Rome some fragments of Greek MSS., and one of a Latin MS.; and experiments that I have made upon them indulge me to hope that a modification of the process just referred to will considerably assist the separation of the leaves, even when they are not adherent; and that another modification of it will apply to those specimens containing earthy matter, where the letters are not destroyed.

Every thing I have seen or done confirms my opinion, that the resources of chemistry are applicable, in a variety of instances, to this labour; but it must be always recollected, that after the separation of the leaves, there must be great care, great nicety of mechanical operation, and great expenditure of time, in preserving them, in attaching them to a proper basis, in reading and copying them; for, in their most perfect state, they become mere broken layers of carbonaceous matter, upon which the charcoal of the characters is distinguished only by its difference in lustre or in shade of colour.

Hitherto there have been no systematic attempts to examine in detail all the MSS. which contain characters, so as to know what is really worth the labour of unrolling and preserving; but this clearly is the plan which it would be most profitable and useful to pursue. The name of the author has generally been found in the last leaf unrolled; but two or three of the first columns would enable a scholar to judge of the nature of the work, and by unrolling a single fold, it might be ascertained whether it was prose or verse, or historical, or physical, or ethical. By employing, according to this view, an enlightened Greek scholar to direct the undertaking, one person to superintend the chemical part of the operation, and from fifteen to twenty persons for the purpose of performing the mechanical labour of unrolling and copying, there is every reason to believe, that in less than twelve months, and at an expense not exceeding 2,500*l.*, or 3,000*l.*, every thing worth preserving in the collection would be known, and the

extent of the expectations that ought to be formed, fully ascertained.

It cannot be doubted, that the 407 papyri, which have been more or less unrolled, were selected as the best fitted for attempts, and were, probably, the most perfect; so that, amongst the 100, or 120, which remain in a fit state for trials, even allowing a superiority of method, it is not reasonable to expect that a much larger proportion will be legible. Of the 88 MSS. containing characters, with the exception of a few fragments, in which some lines of Latin poetry have been found, the great body consists of works of Greek philosophers, or sophists; nine are of Epicurus, thirty-two bear the name of Philodemus, three of Demetrius, and one of each of these authors, Colotes, Polystratus, Carniades, and Chrysippus; and the subjects of these works, and the works of which the names of the authors are unknown, are either natural or moral philosophy, medicine, criticism, and general observations on the arts, life, and manners.

It is possible that some of the celebrated long-lost works of antiquity may still be buried in this collection; but the probability is, that it consists entirely of the works of the Greek sophists and of Roman poets, who were their admirers. When it is recollected, however, that Lucretius was an Epicurean, a hope must arise with regard to the Latin works; but, unfortunately, the wretched and mutilated appearance which they exhibit (they are in a much worse condition than the Greek works) renders this hope extremely feeble: for no powers of chemistry can supply lost characters, or restore what is mechanically destroyed.

At all events, an acquaintance with the contents that remain of the whole collection, must afford much curious and useful information, respecting the state of society, literature, science, and the arts, amongst the ancients, and particularly in the Greek colonies of Magna Grecia and Sicily; which, at one period, were the rivals in civilization and glory of their illustrious mother country; and when so small an expenditure will probably be required, the undertaking, surely, is not unworthy the attention of a great and enlightened government. Much of what has been already done

has arisen from the munificent patronage of His Royal Highness the Prince Regent, and under his auspices; and in the present prosperous times and happy relations of the British and Neapolitan Governments, the enterprise might be resumed with every prospect of success. These MSS. have not, like works of art, any external value; as long as they remain untouched in the museum, they are mere masses of decayed vegetable matter, and the only glory and use in possessing them, depend on their contents being made known to the literary world *.

Rome, Feb. 12, 1819.

ART. XXI. *A few Facts relative to* Dr. Wilson Philip's *Attack on the President and Council of the Royal Society.*

DR. WILSON PHILIP, in the 279th and following pages of the second edition of his Experimental Inquiry into the Laws of the Vital Functions, has made an attack upon the President and Council of the Royal Society, for having had a paper pinned into the copy of his experiments and observations, which is preserved in their archives; and desires to know how it came there. The Editor of this Journal hopes the explanation that follows will prove satisfactory, and exculpate the Council from any intention of hostility towards Dr. Wilson Philip.

When the paper was read before the Society, there were many members who thought it was right that one of the experiments should be repeated. Three members of the Society undertook this task, one conducting the galvanic part; another, the anatomical part; and the third, who was not made acquainted which was the galvanized rabbit, was called in after the experiment was over, to

* It is probable that many of the works in the collection at Herculaneum, the names of the authors of which are not mentioned by Greek or Roman writers, were composed by natives of Magna Grecia. In a collection made in Magna Grecia, such works would not be neglected; and in cities like Tarentum, Crotona, Posidonia, Pompeii, &c., the state of civilization implies a state of activity, both in literature and in science: the schools of Pythagoras and Archytas, alone, must have furnished numerous works.

decide upon the stomach in which the food was most acted upon: that the experiment might be repeated with the greater accuracy, the paper was put into these gentlemen's hands, who implicitly followed the directions contained in it. These gentlemen were quite competent to the task, and each confined himself to his own department; the third, who was employed to examine the contents of the two stomachs, after an accurate inspection, was unable to detect the slightest difference between them. This result was stated to the President, to whom it was also explained, that the rabbit, which is a species of ruminant, does not digest its food, till it has gone through a previous process of maceration, and is therefore not so well fitted for such experiments, as animals that live on animal food. The manuscript dissertation of Dr. Philip was then returned to the clerk of the Society, and a minute, made during the time of the experiments, was accidentally left in it.

Dr. W. Philip's account of his experiment, and that of the experiment made by the members of the Royal Society, are subjoined, for the information of the Public.

Experiment made by Dr. Philip.—The hair was shaved off the skin over the stomach of a young rabbit, and a shilling bound upon it. The eighth pair of nerves were then divided, and about a quarter of an inch of the lower part of each coated with tin foil. The tin foil and the shilling were connected with the opposite ends of a galvanic trough, containing forty-seven four-inch plates of zinc and copper, the intervals being filled with muriatic acid and water, in the proportion of one of acid to seven of water. The galvanic influence produced strong contraction of the muscles, particularly of the fore limbs, and frequently the pain it occasioned was such that the animal cried out violently, and made it necessary for a little to discontinue the process.

For five hours the animal continued quite free from the symptoms which follow the division of the eighth pair of nerves in rabbits. It had neither vomited nor been distressed with dyspnœa. It had not eaten any thing after the nerves were divided. At this time the power of the trough became much weaker, so that it produced no visible effect on the muscles. The respiration now began to be disordered. In a quarter of an hour it became so

difficult, that the animal appeared to be dying. It was gasping. Acid was put into the trough till the galvanic power became as great as at first. Soon after this, the animal ceased to gasp, and breathed with much greater freedom. The galvanic process was several times discontinued and renewed, so that we repeatedly saw the gasping and extreme dyspnœa return on discontinuing, and disappear on renewing it. The animal seemed now much exhausted, and could scarcely raise itself. It had been held down on its side during the whole experiment. It died in six hours after the division of the nerves.

On opening it, we found the œsophagus perfectly natural, and no food in it. The stomach was not larger than usual. The food had undergone considerable change. The appearance and smell of the parsley were gone. The smell was that of the rabbit's stomach while digestion is going on, which is peculiar. Mr. Hastings, who has been much accustomed to examine the stomach of rabbits under various circumstances, said that digestion was nearly as perfect as it would have been in the same time in a healthy rabbit.

The membrane of the trachea was of its natural colour, and there was no fluid in it. The ramifications of the bronchiæ in the left lung were quite free from frothy mucus. There was some fluid in the right lung, though it did not appear much gorged; there was one dark spot on it. The lungs collapsed imperfectly on opening the chest.

This rabbit had not eaten any thing for twelve hours till within three hours of the operation, during which it was allowed to eat as much parsley as it chose.

Experiments made by Three Members of the Royal Society.

Two rabbits, which had had no food for seventeen hours, were allowed to eat as much parsley as they chose. The nerves of the par vagum were then divided in the neck of both rabbits. One of them was allowed to remain quiet. A slip of tin foil was connected to the lower divided ends of the nerves of the other rabbit, and another piece of tin foil, an inch square, was applied to the abdominal muscles over the stomach and under the integuments, by means of a wound in the latter. The tin foil over the stomach was con-

nected with a wire, communicating with one end of a charged voltaic battery of twenty plates, and occasional contacts were made (about three or four times in a minute) between a wire connected at the other end of the battery, and the tin foil round the nerves in the neck. The influence of the battery was sufficiently strong to excite slight contractions of the muscles of the fore legs. This process was continued during five hours, at the end of which time both rabbits were killed. On examining the stomach of the animal, which had been subjected to the influence of the battery, it was found much distended with food. The parsley was principally in the cardiac portion: near the œsophagus it appeared to have undergone no alteration, and below this it was mixed with other food in the stomach, so that no accurate observation could be made on it.

The stomach of the other rabbit was examined by the side of the first, so that they might be compared together, *and the appearances were precisely the same as those, which have been just described.* The contraction of the centre was somewhat greater in the galvanised stomach than in the other*.

Dr. Philip says, that in his experiment there were muscular contractions produced by the galvanic influence; which proves that he employed it, not in a continued stream, but by occasional contacts, as in the experiment made by the members of the Royal Society.

Dr. Philip, in his account of the latter experiment, has left a blank where the names of the nerves should have been inserted, whereas the words *par vagum* were written as plain as any other part of the paper.

In this experiment, it was not observed that the galvanic influence produced any change on the respiration, the dyspnœa being equal, whether the battery was in force or not: In Dr. Philip's first experiment, he says, that the dyspnœa was entirely relieved by the galvanism: yet the animal died at the end of six hours. What then was the cause of death?

* In this experiment, the respiration was affected, as usual, after the division of the eighth pair of nerves, and it was not observed that the dyspnœa was at all relieved by the galvanic influence.

The gentlemen concerned in the experiment, not being able to devote so much time as in Dr. Philip's second experiment, the experiment was continued during five hours, which is nearly the time with that in Dr. Philip's first experiment, which was continued for six hours. One of the gentlemen employed in making these experiments, started many objections to dividing the par vagum in the neck; he stated, that if the nerves of the eighth pair be divided in the neck, the digestion of the animal is impaired, but this affords no satisfactory proof of these nerves exercising a direct influence over the functions of the stomach, since these functions may be affected, in consequence of the disturbed state of the respiration, which this injury occasions, and of the imperfect alteration of the blood in the lungs. The following experiments, in which the same nerves were divided below the origin of the branches, which are distributed to the lungs, appeared to him to be free from objection, and are here given with a view to throw further light on this subject.

Experiment II.—In a young cat, the termination of the nerves of the eighth pair, on the cardia of the stomach, were carefully divided. The animal was perfectly well afterwards; was lively; ate his food as usual; and the respiration was, of course, unaffected. At the end of a week, and three hours after having been fed with meat, the cat was killed.

On dissection, digestion was found to have been going on as usual. The food in the stomach was in a great measure dissolved, and the thoracic duct and lacteals were distended with chyle, having the ordinary appearance. The nerves were carefully traced, and it was ascertained that not the smallest filament had been left undivided. This experiment was repeated with exactly similar results.

These experiments appear to set this inquiry at rest, and to disprove the experiments made by Dr. Wilson Philip. It was intended to have laid them before the Royal Society, but the morbid sensibility shown by so many members on hearing the experiments detailed by Dr. Wilson Philip, deterred the author from running the risk of so soon again awakening these feelings.

ART. XX. *The following Papers have been read at the Table of the Royal Society, since the commencement of the present Session.*

NOV. 5, 1818.—The Croonian Lecture on the conversion of pus into granulations of new flesh, by Sir Everard Home, Bart.

NOV. 12.—On the laws which regulate the absorption of polarised light by doubly refracting crystals, by David Brewster, L.L. D.

DEC. 10.—Observations on the decomposition of starch by the action of air and water at common temperature, by M. Theodore de Saussure, communicated by Dr. Marcet.

DEC. 17.—On the solution of some problems relating to games of chance, by Charles Babbage, Esq.

DEC. 24.—On the antiseptic properties of peat moss, viewed as a preventive of dry-rot in wood, by Captain Arch. Duff, R. N.

JAN. 14, 1819.—On the corpora lutea, by Sir Everard Home, Bart.

JAN. 21.—Remarks on the advantage of multiplied observations in the physical sciences, and on the density and internal structure of the earth, by Dr. Thomas Young, for Sec. R. S.

JAN. 28.—Memoir of a survey of the province of Kumaon, by Captain W. S. Webb.

An experimental inquiry upon gas light on the continent, with some observations upon the present state of the illumination of London, by Professor Aldini.

FEB. 4.—On the anomaly in the variation of the magnetic needle, as observed on board ship, by William Scoresby, jun. Esq.

On the dangers to which navigation is exposed, by navigators neglecting to make the local attraction on ship-board an element of calculation, by W. Bain, Esq.

Extract of a letter from Thomas Ley, Esq., of Philadelphia, to Dr. William Elford Leach, on the subject of the Genus Ocythoe.

Arithmetical investigations upon the extraction of roots, by Lewis Francis Bastard, Esq., of Geneva.

Feb. 11.—On the variation of the compass, by John Ross, Captain, R. N.

Feb. 18.—On the irregularities of the compass needles of H. M. SS. Isabella and Alexander, caused by the attraction of iron contained in them, by Captain Edward Sabine, Royal Artillery.

Feb. 25.—Some observations on the formation of mists in particular situations, by Sir Humphry Davy, Bart.

Observations on the dip and variation of the magnetic needle and intensity of the magnetic force, made during the late voyage in search of a north-west passage, by Captain Edward Sabine, Royal Artillery.

On the action of crystallized surfaces upon light, by Dr. David Brewster.

March 4.—An account of the fossil skeleton of an animal, several parts of which have been described to the Society in three separate papers, by Sir Everard Home, Bart.

March 11.—On the pressures which sustain a heavy body in equilibrium, when the points of support are more than three, by Charles Bonnycastle, Esq.

Art. XXI. *Miscellaneous Intelligence.*

I. Mechanical Science.

§ 1. Astronomy, Optics, Agriculture, the Arts, *&c.*

1. *Theory of the Rainbow.*—A new theory of the common rainbow has been advanced by Dr. Watt, of Glasgow, by which he accounts for the effect without refraction in small drops of water. The rainbow, it is stated, is frequently seen towards the quarter where no rain is falling, and where, of course, it cannot be caused by drops; but it is observed, as a constant attending circumstance, that the edge of a cloud is always at those times between the observer and the sun; and Dr. Watt attributes the rainbow to the beams of the sun refracted by this edge, and thrown on to the dark sky opposite, which receives them as a screen. The cause and effect are said to be so closely connected, that, with a little practice, the appearance of the bow may often be predicted from the state of the clouds, with great certainty. There are, however, many phenomena which cannot be explained in this way, and which so exactly resemble the rainbow, we can scarcely separate them. The bow formed in the mist of a cataract, as at Terni, or that produced by throwing water from a syringe against a wall, or any obstacle opposite, must be accounted for by refraction in drops; and where the shower is seen falling, and the tints of the rainbow seem to clothe the buildings or other objects beyond them, the phenomenon appears to have the same origin.

2. *New Comet.*—A comet has lately been discovered at the observatory of Konigsberg, in the constellation of the Swan. It is not visible to the unassisted eye.

3. *On Budding, and on the Fig Tree, in a Letter to the Editor.*

Sir,—Whether the following brief observations and notice of improvement in two operations of the art of horticulture may be of sufficient importance to obtain the honour of occupying a page in some future number of the Journal of Science and the Arts must be left to better judgment than that of their author to determine.

When I first began to practise *budding* or *inoculating* in the above art, conformably to the directions of gardening books in general, and those of Miller and Mawe and Abercrombie in particular, I made the transverse cut in the bark of the stock *above*, and the longitudinal slit *beneath*, and consequently thrust the bud *downwards* to its place of rest, and was very often mortified by

a want of success. The Rev. I. Lawrence's treatise on the same subject, entitled *The Clergyman's Recreation*, recommends a method the reverse of this; that is, to make the transverse cut *beneath*, and the perpendicular one *above*, and thus to lead the bud *upwards* to its position; by following this direction I have seldom failed in the operation. It was formerly supposed that the sap *ascended* in the vessels of the bark and between that and the wood: *now* it is ascertained that it *descends* in those vessels; the reason of the better success of my latter mode of practice is obvious; the bud in the *superior* position receiving an immediate and plentiful supply of sap, which is denied to it by the cross cut obstructing and diverting the invigorating fluid, in the *inferior* situation.

It is well known, that fig-trees (*ficus carica*) produce a second crop of green figs in the autumn in much greater abundance than the spring crop. As these autumnal figs are never known to ripen in this country, they should be rubbed off as soon as they make their appearance, which is often early in August, and through that month and September. I have not seen one gardening directory where this is recommended to be done till the month of November; by which time they are grown many of them to nearly their full size. By suffering them to remain till this period, the trees will have been supporting and maintaining the greater part of this useless burthen of fruit for at least three months, and must be supposed to be in consequence much weakened by it, and rendered indisposed to produce fruit in the following spring. Besides, the breaking off these immature figs when their stems are become large, unavoidably occasions considerable wounds in those young shoots to which they are attached; which, as the sap is then at rest, are not so readily disposed to heal, and from this circumstance are commonly killed (at their extremities at least), by the frosts immediately succeeding and attacking them in their unhealed state. Rubbing off these autumnal fruit as soon as they appear, leaves neither wound nor scar of any consequence; and *two* figs may very often be observed in the spring to issue at the very joint where *one* was rubbed off. When I first attempted this innovation, I had some suspicion that it would tend to force out more young fruit at that improper season, which might otherwise remain latent till the spring, but I never found my suspicion to be realized. With the above management strictly adhered to, I have very seldom known my fig-trees fail of displaying an abundant shew of fruit at the proper season.

Travellers tell us, that in those countries where the fig-tree is indigenous these autumnal fruits ripen as well as the spring crop. But if they do so, the supporting and ripening two crops in one year must, surely, prevent those trees subject to so great exertion, generally, from bearing fruit the following year. We know that *one* full crop of fruit commonly disables many of our fruit-trees,

apples, for instance, or apricots, (if the fruit of these latter are not duly and seasonably thinned), from producing fruit the next season. And much more may we expect this effect to follow when *two* crops, (indeed, Dr. Shaw says, that sometimes *three* are ripened), are born and matured in one year. Should, however, what I have just supposed be the fact, it would completely remove the difficulty apprehended in the account of the fruitless fig-tree in St. Mark's Gospel*, and Dr. Hammond's interpretation of that disputed passage would be the true one, Οὐ γὰρ ἦν καιρὸς σύκων. For, (not as our translation has it "the time of figs was not yet," but literally), it was not a season of figs;—it was not the fig-year;—the fruit-bearing year for that particular tree.

I am most respectfully your's,
G. SWAYNE.

Dyrham Rectory, near Bath.

4. *Prevention of injury to Plants from Insects.*—We recommend to gardeners and others, at this season of the year, the use of the ammoniacal and tarred liquor, obtained from the distillation of coals in the making of gas, for the purpose of keeping grubs and other insects from trees and plants, and of destroying them. The fluid is not at all hurtful but rather beneficial to the plants, and if merely put round wall-trees on the wall and ground, will keep the snails and other insects from them.

5. *New Light-houses.*—A light-house has been erected at the point of Ayre, at the Northern extremity of the Isle of Man; and two others have also been erected on Calf Island, at the Southern extremity of the Isle of Man. They were lighted on the evening of Monday, February 1, and will henceforward be lighted from evening till morning.

6. *Substitute for Lithographic Stones.*—A mixture of plaster of Paris and alumine, left to harden in a smooth metallic mould, is said to answer perfectly well in the place of limestone in the lithographic art.

7. *Grass Rope.*—Experiments have been made at Portsmouth on the application of a grass, a common product of New Zealand, to the manufacture of large and small ropes, of which a favourable report has been given. The grass is strong, pliable, and very silky in its nature, and may be cut thrice a year. It may be brought into this country at the estimated price of eight pounds per ton, or about one-seventh the price of hemp.

8. *Premium for Flax.*—A premium of fifty pounds has been offered by the Prince Regent, as duke of Cornwall, and lord of

* Mark xi. 13.

the forest of Dartmoor, to the person who this year shall cultivate the greatest number of acres in flax.

9. *Linen and Thread from Nettles.*—Some experiments on the preparation of linen and thread from the flos of nettles have been made lately in Ireland. The thread in colour, strength, and fineness, was equal, if not superior, to that obtained from flax, and the linen had the appearance of common grey linen.

II. Chemical Science.

§ 2. Chemistry.

1. *On Nitric Acid; in a Letter to Andrew Ure,* M.D., M.G.S. *by* Richard Phillips, F.R.S.E., F.L.S., *&c.*

Sir,

I request your attention to some additional observations respecting nitric acid. If language has any meaning, you still claim as your own discovery, the exact composition of this acid. I am prepared not only to vindicate the correctness of my former statements, but again to incur accusations of ignorance, and bitter reproaches, for questioning the justice of your pretensions. Your first paper *, upon which I have already offered some remarks †, I shall refer to as the *memoir*, and the second ‡ which is the more immediate subject of my present communication, I shall denominate the *reply*.

In my remarks on the *memoir*, I observe that you had denied the correctness of every previous analysis of nitric acid; in the *reply* you say, "this is a mis-statement of my language. In a short introductory paragraph of eleven and a half lines, I detail from Doctor Henry the discordant numbers of two eminent modern chemists. But I no where assert that every previous analysis was incorrect." Now, Sir, permit me to refer to this paragraph, and to examine what occurs in addition to your present description of its contents: of nitric acid you say, "the exact proportion of its two constituents, azote and oxygen, is a problem which seems hitherto to have baffled the best directed efforts of modern science. M. Gay Lussac states, as its composition in 100 parts,—30.4 azote + 69.6 oxygen; and Mr. Dalton 26.7 azote + 73.3 oxygen. Thus discordant," you exclaim, "are the latest determinations. I hope soon to be able to present to the public some researches, which may possibly tend to clear up this mystery."

Allow me to inquire, how the best-directed efforts of modern

* Journal of Science and the Arts, Vol. 4, Page 291.
† Ditto Ditto Vol. 5, Page 162.
‡ Ditto Ditto Vol. 6, Page 242.

science can be said to be baffled, if any one analysis is correct? If this is the case, where is the problem to be solved, or the mystery to be cleared up? Experience must have taught you, that of two discorded statements one may be true. Your analysis of liquid nitric acid, for example, differs from that on the synoptic scale; one may possibly be correct, but according to your method of deciding, discordance is equally fatal to the correctness of both.

When a question arises as to the periods at which certain events have occurred, it is convenient to refer to dates; by adopting this plan, you would have found that M. Gay Lussac's analysis was published in 1809, and Mr. Dalton's in 1810, and these you assert to be the "latest determinations:" whereas Sir H. Davy's analysis appeared in 1812, the synoptic scale in 1814, and M. Gay Lussac's corrected analysis in 1816.

You are inclined in the *reply* to be pleasant with the observation "that the number representing a compound body cannot be ascertained without a previous knowledge of the proportion of its constituents." You must be aware, that this was not advanced as a general proposition, but merely with reference to the theoretical mode of determining the composition of substances. This method I conceived it to be possible (however improbable) that you had adopted, without making any experiments yourself, or claiming the result of those performed by others. I find, however, in the reply, that my suppositions were erroneous; you had satisfied yourself it seems "of 67.5 being very nearly the equivalent for nitric acid. It was gratifying," you add, "to have the concurring authority of Dr. Wollaston for nearly the same number."

Allowing, Sir, that by correctly analyzing a nitrate, you had determined the equivalent for nitric acid, still the acquisition would no more have informed you than Richter, of the composition and atomic constitution of nitric acid; and yet we find you acquainted with both these facts, and stating them, in the *memoir*, without detailing or claiming to have made a single experiment to determine the equivalent for azote. Under these circumstances, I was naturally induced to examine how far you may have acquired your information from those philosophers whom you denounce as "baffled." The authority to which I shall first refer is the synoptic scale; with this instrument you confess that you have been long acquainted, and you even quote it in the *memoir* as to the composition of liquid nitric acid, and whilst referring to it you must have perceived, that dry nitric acid is represented "very nearly 67.5". Supposing the scale then to have afforded you no further information, it must at least have taught you the equivalent for nitric acid: and allowing that you could possibly fail to acquire the knowledge of its composition and atomic constitution from the same source, I shall inquire what additional opportunities presented themselves for the attainment of this information. You

quote from Dr. Henry's Elements of Chemistry some facts respecting nitric acid; but you have totally omitted to notice others, although they are closely connected with that part of the subject of which you were treating. Dr. Henry observes, that Dr. Wollaston " infers the oxygen which nitric acid contains to be by weight to the nitrogen as 50 to 17.54;" and he remarks that this acid " will consist of five atoms of oxygen, and one atom of nitrogen; he shows also, that Sir H. Davy's analysis agrees very nearly with that on the scale, the proportions being 50 oxygen + 17.48 azote, instead of 50 oxygen + 17.54 azote.

You can scarcely plead ignorance of these statements, they commence at p. 364, vol. I. of Dr. Henry's work; and you refer to, and quote from, this very page. Had you, however, stated and compared the results of Sir H. Davy, and Dr. Wollaston, you must have lost the opportunity of adding, " thus discordant are the latest determinations."—In the opinion of most persons no problem would have remained to be solved, nor could you have discovered any mystery, " to clear up;" and instead of congratulating yourself upon the " concurring authority of Dr. Wollaston," you must have been content with the humbler satisfaction, of giving your support to a statement which requires none.

In my remarks, I observe, that it would have been candid in you to have excepted Dr. Wollaston from those whose efforts had been baffled. " This," you say, " is a curious remark. Does not Dr. Wollaston, with the candour characteristic of a superior mind, renounce his own result, and follow in preference the determination of a German chemist?" To this inquiry I answer confidently, that he does not. It is of nitric acid, and not of nitrate of potash, that we are treating: and, when claiming as your own discovery, that 67.5 is nearly the equivalent for nitric acid, it was " gratifying to have the concurring authority of Dr. Wollaston for nearly the same number:" but when the fact must be admitted in a mode less flattering to your pretensions it becomes the determination of " a German chemist."

Among other remarks upon the *memoir*, I state, that your analysis of liquid nitric acid of specific gravity, 1.5, exhibits internal proofs of inconsistency and error. This assertion, and some observations connected with it, you characterize as a " most ludicrous blunder, perhaps the most absurd on record," *&c. &c.*, as indicating a " confusion of intellect bordering upon fatuity;" and you ask, " who ever dreamed, before Mr. P., that either nitric or any other liquid acid, would refuse to combine with water, in any proportion, however indefinite?" *&c. &c.* " What mystic charm," you inquire, " resides in the number 1.5, why nitric acid should, at that density, and no other, consist of one atom of dry acid and two of water?"

By employing the term *liquid* acid, you have totally mis-stated the nature of the question at issue; or rather, you have created

a phantom, attribute it to me, and then combat and conquer it with your accustomed adroitness. The question for decision is, what quantity of *dry* nitric acid will refuse to combine with water; we need not, therefore, dwell on the mystic charms of 1.5, but determine whether liquid nitric acid, of this density, is, or is not, a definite compound of water and dry nitric acid.

You will, I presume, admit that concentrated liquid sulphuric acid is a definite compound of one atom of dry acid, = 50, one atom of water = 11.32; and also, that nitrate of potash is a definite compound of one atom of dry nitric acid = 67.5, one atom of potash = 59.6. I suppose you will also allow, that when two definite compounds mutually decompose each other, the resulting compounds are also definite; and you agree with me, that when liquid nitric acid is procured from nitrate of potash by the action of concentrated liquid sulphuric acid, its specific gravity is 1.5. What might naturally be expected in this operation is, therefore, that whilst the sulphuric acid deprived of water combines with the potash, the nitric acid separated from the potash, would combine with the water, and that the atom of nitric acid and water rising together in distillation would combine, and form liquid nitric acid. On this supposition, nitric acid of 1.5 must consist of 67.5 one atom of dry acid + 11.32 one atom of water; which is 5.85 of water less than your determination, and only half the quantity indicated by the synoptic scale.

Here then, sir, it would appear, that the water of an atom of liquid sulphuric acid is not sufficient to condense an atom of dry nitric acid; and let us examine whether, by referring to the paper on the synoptic scale, we may not be able to clear up this mystery. "In the distillation of nitric acid from nitre," says Dr. Wollaston, "the whole of the acid may be obtained, if we employ enough of sulphuric acid to convert the residuum into bi-sulphate of potash. In this case, each portion of potash, from which dry nitric acid is separated, will displace the water from two equivalent quantities of sulphuric acid, and each portion of nitric acid weighing 67.54 will be found combined with 22.64 of water." By this operation, you will scarcely dispute, that liquid nitric acid of 1.5 is obtained, composed according to your experiments of 67.5 one atom of dry acid + 17.17 of water, exceeding one atom of water by 5.85 and less than two atoms by 5.47. You would charge me with obtuseness of intellect, if adopting your analysis of this acid, I stated it to be a compound of one atom of dry acid + 1.52 atom of water; and, I must confess that, assisted by your mathematical knowledge, you have contrived a notable expedient for obviating this evident absurdity. You obliterate the decimal point, and then find, that the acid in question is composed of 100 atoms of dry acid + 152 atoms of water.

Admitting the possibility of obtaining this unheard-of congregation of atoms, let us inquire into the nature of the operation required for

its production. You have justly ridiculed the idea that liquid nitric acid and water cannot combine in unlimited proportions; you must therefore suppose, that in distillation, liquid acid of 1.5 is formed, only when the requisite quantities of acid and water have an opportunity of combining. For this purpose 100 atoms of nitrate of potash, containing 100 atoms of dry nitric acid + 100 atoms of potash, must be decomposed by 152 atoms of liquid sulphuric acid, consisting of 152 atoms of dry sulphuric acid + 152 atoms of water. In the receiver, there will be of course an atom of liquid acid of 1.5, constituted of 100 atoms of dry acid + 152 atoms of water; and in the retort, there must remain an atom of a salt composed of 152 atoms of dry sulphuric acid + 100 atoms of potash, nearly intermediate between sulphate and bisulphate of potash. To express the excess of acid, you may describe this salt as a supersesquisulphate of potash.

Absurd as this statement is, I think it as plausible as any other theory to account for the distillation of the acid you describe, by the action of concentrated oil of vitriol upon nitre. I have no doubt, however, that you will be able to furnish several explanations, by slightly extending a principle which you have adopted in the *reply*. Alluding to the equivalents for the vegetable acids, you assert, that "after this is found, we may distribute the proportions of their constituents, hydrogen, carbon, and oxygen, very much according to fancy." The equivalent for an acid being known, we may then disregard or falsify analysis, and state the acid to be composed of any proportions of hydrogen, carbon, and oxygen, provided their amount agrees with that of the equivalent. If this opinion is the result of your attainment in chemical science, I am content that you should impute ignorance to me, for I conceive it impossible to form a conclusion more directly at variance with sound philosophy, than your proposal to substitute fancy for fact; but, I am willing to do you the justice of admitting, that your theory and practice are in perfect unison.

Another remark of mine which excites your censure is, that nitric acid of 1.496 may be considered as identical with that of 1.5 in experiment; now to this assertion I will add another, *viz.*, that any one acquainted with the circumstances under which the acid of 1.5 is procured, would form precisely similar conclusions as to its composition, whether he used the stronger or the weaker acid. By your table (allowing for a moment that it is correct), the weaker acid contains* 1.6 per cent. more water

* The difference shewn by your table is even rather less than 1.6, which you assert "is as nearly as possible 2." I was certainly unfortunate in considering 1496 as nearly identical with 1500. Had I said, that these numbers, or even that 16 and 20 are "as nearly as possible" the same, your mathematical exactness would not have been offended.

than that of 1.5; no one then could doubt, when he found acid of 1.496 formed of 67.54 one atom of dry acid and 23.24 of water, that the acid of 1.5 must consist of 67.54 one atom of acid + 22.64 or two atoms of water. Again, you criticise the experiment by which with the weaker acid I procured more nitre, than, according to the synoptic scale, I ought to have done with the stronger acid; why, Sir, I was "baffled," and my confession of this was rather more than tacit, for, after stating the result I had obtained, and comparing it with the scale and with yours, I drew no inference from it; but added, "it is easier, for obvious reasons, to obtain more accurate results with carbonate of lime than with carbonate of potash:" and I then stated the experiment upon which I founded my opinion of your inaccuracy, and of the correctness of the synoptic scale.

Of this statement, in which I give preference to carbonate of lime, you say, "here we have an assumption bold, gratuitous, and false. If his reasons be obvious, they are so only to himself;" and you afterwards add, "I hope to be able to shew that there are sufficient reasons, of which no good practical chemist need be ignorant, why results of the rigid accuracy, required by the doctrine of equivalents, cannot be obtained by employing carbonate of lime to saturate liquid nitric acid."

You have thus severely censured the opinion, that carbonate of lime is preferable to other substances, for the purpose to which I applied it; and yet, if I was to claim it as my own discovery, I might adopt your language upon a similar occasion, and say of this opinion, that "it is gratifying to have the concurring authority of Dr. Wollaston for nearly the same," contained in the following passage from the Memoir on the Synoptic Scale. "The real measure by which most bodies are compared to each other, in any experiments that I have made, and to which I have, in fact, endeavoured to find equivalents, is a determinate quantity of carbonate of lime. This is a compound that may be regarded as most distinctly neutral. It is most easy to obtain in a state of uniform purity; most easy to analyze (as a binary compound); it is a most convenient measure for the powers of acid, and affords the most distinct expression for the comparative neutralizing powers of alkalies." You will make but few converts to your opinion, that these determinations are "bold, gratuitous, and false."

In concluding, I deny your assertion, that I have treated you with "virulence of abuse," but having, as I conceive, temperately shewn, that your experiments are fallacious, and that your claims to originality are groundless, I leave the coarse invective which you have lavished upon me, to recoil upon yourself.

I am, Sir, yours, &c.

London, Feb. 1819. R. PHILLIPS.

2. *Production of Cold.*—The various methods adopted for the production of low temperatures, by artificial means, have been founded principally on the change of a body from one state to another, the change generally being from the solid to the fluid state, though in the most refined processes of the kind, as Mr. Leslie's, it is from the fluid to the gaseous state. The various circumstances which attend those operations, and the peculiar relations of the bodies to heat, prevent a very low temperature from being attainable, and, compared with the means we have of elevating the heat of bodies, the most distant is but a slight departure from the common temperature of the atmosphere.

M. Gay Lussac has proposed another method of producing cold, which may be extended *ad infinitum;* but which suffers under the disadvantage of being applicable to but small masses of matter.

All bodies change their temperature with their bulk, the former increasing if the latter is diminished, but diminishing if it is increased. If air be compressed to one-fifth its former volume, it will inflame tinder; and to do this it requires a heat more than sufficient to melt bismuth, or about 300° centigrade, (572° Fahrenheit.) The air, therefore, has been thus heated by compression into one-fifth its former bulk, and we can easily suppose the capability of raising it to 1,000° or 2,000° (centigrade) if it be strongly and rapidly compressed.

If, therefore, a portion of air, compressed by five atmospheres, and reduced to the common temperature, be suffered to dilate instantaneously, it will absorb as much heat as it gave out on compression; and, supposing the capacity of the air to remain constant, will be reduced in temperature 300° centigrade (572° Fahrenheit), *&c.*; and taking air compressed by fifty, one hundred, or more atmospheres, the cold produced by intsantaneous dilatation will have no limit.

The effect of a process of this kind is shewn by compressing two or three atmospheres into a vessel holding between six and seven pints, and, when cold, allowing it to escape rapidly by a short tube; if the current be directed on to a thin glass ball about the fifth of an inch from the orifice, a coating of ice will be constantly formed even in the midst of summer.

The dilatation of air is evidently a superior means of producing cold, to a change of state; but it is to be regretted, that, from the small density and mass of air, the cold is instantaneous. Nevertheless, by using gases having a greater capacity for heat than air, by compressing them in large vessels, by mixing volatile substances with the gas, which may form vapour, and by acting only on small portions of matter, many instructive experiments may be made.

If it be certain that, by the expansion of a gas, an unlimited degree of cold may be produced, then the question of an absolute Zero will appear very chimerical.—*Annales de Chimie.*

3. *Gallic Acid.*—M. Henri Braconnot offers a process to the scientific world for the preparation of gallic acid, which, if constantly successful, is no small improvement on the usual mode, both as to time occupied, and quantity obtained:—250 grammes (about 8 oz.) of powdered gall-nuts were infused for four days in a litre (2 ⅛ pints) of water, being agitated occasionally; the whole was thrown on a cloth, and the residue strongly pressed; the fluid was then filtered, and left in a glass bottle, covered with paper, for two months. It deposited much gallic acid in crystals, and, removing the mould from the surface first, they were separated from the fluid by a cloth and pressure. The deposit thus obtained was principally gallic acid. The liquid was evaporated until like a syrup, and in twenty-four hours gave a fresh crop of crystals, which were separated by pressure in a cloth. The solid refuse of the first infusion had been moistened with water, and left to ferment at the same time with the infusion; and it afterwards gave, by the action of boiling water, a quantity of the crystallized acid. When put together the quantity of dried crystals equalled 62 grammes (nearly 2 oz.,) but they were mixed with an insoluble powder; they were boiled in three decilitres (18.3 cubic inches) of water, and filtered; 10 grammes (154.5 grains) of a peculiar substance remained on the filter, and the solution when cold deposited crystals, which, when pressed and dried, weighed 40 grammes (617 grains,) they were of a fawn colour; and 10 grammes (154.5 grains) more were obtained by carefully evaporating and crystallizing the mother liquor. In this way a full fifth of the nut-galls was obtained in the state of gallic acid, purer than by Scheele's process.

Gallic acid was obtained still more readily, and in great quantity, by exposing nut-galls to a temperature of 20° or 25° (68° or 77° Fahrenheit) for a month, moistening them now and then; they swelled considerably, became mouldy, and at last formed a whitish paste, which, when separated by pressure from the coloured liquid it contained, required only to be treated with boiling water to dissolve out the acid; the solution separated by pressure, and, cooled, gave a crystalline magma of gallic acid.

M. Braconnot purified his gallic acid by animal charcoal, *i. e.* the ivory-black of the shops, washed in muriatic acid; 100 parts of coloured gallic acid, 800 parts of water, and moist animal charcoal equal to 18 parts when dry, were put into a bottle, and exposed to the heat of boiling water for fifteen minutes, the filtered liquid, left to cool, and agitated now and then, became a mass of white gallic acid, from which the excess of fluid was separated by pressure. Thus obtained, it was as white and pure as other crystallizable vegetable acids; its aqueous solution did not affect solution of gelatine, and it crystallized from hot water in needles white as snow.—*Annales de Chimie*, 181. t. 9.

4. *New acid.*—M. Hauton Labilliardiere has re-examined the re-

sults of the distillation of mucous acid, and finds a new acid among them, different to any noticed by Scheele, or others in their experiments on the substance. To obtain the new acid, mucous acid is to be distilled till nothing remains in the retort but charcoal; a brown acid liquor comes over, and some few crystals attach themselves to the upper part of the retort; these are to be put together and about four times the quantity of water added, the solution is to be filtered and then evaporated until it will crystallize; the crystals are to be separated and the mother liquor again evaporated, that the rest of the acid may be obtained. These impure crystals which are of a yellow colour, are to be distilled in a little retort, at the temperature of 130° centigrade (266° Fahrenheit) then melt and afterwards distil, leaving a very slight charcoal in the retort; the distilled acid is still yellow, but on being crystallized becomes perfectly white and pure.

This acid is called the pyromucous; it is white, inodorous, of a strong acid taste, it melts at 266° Fahrenheit, volatilizes above that temperature, and condenses into a liquid which becomes solid on cooling. It is not deliquescent, it reddens vegetable blues, and is more soluble in hot than cold water; alcohol dissolves more of it than water; analyzed by oxide of copper it gave charcoal 52.118, oxygen 45.806, hydrogen 2.111.

The acid combines with and neutralizes the various metallic oxides, and most of its salts are capable of being crystallized. Its most remarkable salt, is that with oxide of lead; if heated with moist carbonate of lead it dissolves it, and becomes neutral. If the solution of the salt be evaporated, small brown globules collect on its surface, looking like oil; these separated from the solution, and cooled become soft, and ultimately hard, white, and opaque. If the evaporation be continued, more will be obtained, until the whole of the salt has been separated in this form. Its combination with barytes, consists of acid 57.7

acid	57.7
barytes	42.2
	99.9

5. *Tartaric acid from Potato Apples.*—The fruit of the potato contains a large proportion of acid, which is said by Mr. Bainbridge to be tartaric acid with a small proportion of malic acid.

6. *Cyanogen and its Compounds.*—The discoveries made by M. Gay Lussac respecting the nature of the Prussic acid, its elements and compounds, have obliged chemists to take a new view of it in almost all cases in which it is concerned; and though little or nothing remains to be made known to us respecting its constitution, as far as we can perceive, yet many of its habits require revision and re-statement, to be correct. M. Vauquelin has lately been employed in a series of experiments on cyanogen and hydrocyanic acid relating more particularly to the manner of their action on bases. These experiments are minutely described in the

stance, from the bottom of one of the copper melting furnaces in the Mint, which proves to be a mixture of the protoxide of copper with protoxide of iron and silix. The two latter substances came from the sand with which the furnace was lined; the first results from the action of heat and air on copper, and is the first known instance of the formation of this oxide by these means.—*Annals.*

12. *Uses of refuse Oxide of Iron.*—When muriate of soda and sulphate of iron are heated together, a decomposition of the salts takes place, sulphate of soda is produced, which, if washed away, leaves an oxide of iron in a micaceous form. This oxide is sometimes a refuse product in the arts, but for which uses have been proposed in France. It is not difficult of reduction, and if perfect fusion and compactness are not required, may easily be converted, by heating with charcoal, into porous masses of iron, that answer well in the precipitation of copper, and in other processes. But it has been proposed also to use it as a paint for houses and coaches, and also for the paper of rooms, and its effect and appearance, when thus applied, is said to be very good.

13. *Decomposition of Water by Iron.*—M. Guibourt has made experiments, by which he conceives he has proved that iron will decompose water at common temperatures; and farther, that the action is so strong, that when the metal is in a large proportion to the water, even heat is produced; according to him, also, the action is increased by increase of temperature; and from some experiments by M. Robiquet, it appears that the oxide, formed in all cases of the decomposition of water by iron, either at low or high temperatures, is the same. It will be remembered, that Dr. Marshall Hall's experiments produced an entirely opposite conclusion, Dr. Hall denying from their evidence the action of iron on water at common temperatures.

14. *Oxymuriate of Lime.*—Dr. Thomson, in some experiments on the bleaching powder, called oxymuriate of lime, has shewn that it is a compound of chlorine with the earth lime, and not a mixture of the chloride or chlorate of lime. When heated, it gives off oxygen, and a chloride of calcium is formed; 1,160 grains yielded 164 cubical inches of gas.

Dr. Thomson found also that barytes, strontian, potash, and soda, were also capable of being united to chlorine, without the loss of oxygen; and he expects that many of the common metallic oxides will form similar combinations. It is probable that an analogy will be established between these compounds and the peculiar set of bodies which Thenard has produced, by adding oxygen to substances already containing that principle; and that the further prosecution of these experiments, which we have

reason to expect, will illustrate the whole theory of chemical combination.

15. *Sulphate of Strontian used as Flux.*—Sulphate of Strontian is recommended as a flux in place of borax, in the processes of welding and brazing, usual with artizans, and particularly where high temperatures are required. It has been used very successfully in the welding of harsh and refractory steel.

16. *Alkali from Potato.*—M. Vauquelin, in his experiments on the quantity of alkali to be obtained from the leaves and stalks of the potato, finds reason to caution agriculturists against a too hasty adoption of the culture of that plant, for the purpose of obtaining the potash. The quantity of alkali produced varies extremely, with the nature of the soil, being, when carbonated, from one pound and three-quarters to five ounces for every hundred pounds of the green stalks, *&c.*, and it varies also in its proportion to the other salts contained in the ashes of the vegetable, sometimes scarcely having a place.

The quantity of potash yielded by the potatoes is in proportion to the quantity of decomposable salts, as acetates, oxaltes, tartrates, malates, nitrates, *&c.*, which they may contain; a soil, however, would soon be exhausted of these, and though, therefore, where potatoes are cultivated, it may be adviseable and advantageous to burn their leaves, and collect the alkali from them, there is no reason to expect that they would prove a constant source of potash, or that the cultivation of them for the alkali alone would at all compensate the expense incurred.

17. *Gunpowder inflamed without a Spark.*—M. Leroi has communicated experiments to the Royal Academy of Sciences, in which gunpowder has been inflamed by a blow, without the previous production of a spark.

From experiments made in the laboratory of the Royal Institution, it has been found, that if gunpowder be mixed with pulverized glass, felspar, and particularly with harder substances, it may be inflamed by being struck violently on an anvil, though faced with copper and with a copper hammer.

18. *Glowing Lamp.*—M. Sementini has succeeded in making silver wire answer the purpose of the platinum wire in the glowing lamps. From the continued effect of the heat the silver crystallizes and soon becomes very brittle.

19. *New and Delicate Thermometers.*—Il Cavalière Landriani has described in the *Giornale di Fisica*, *&c.*, a method contrived and adopted by himself in the construction of very delicate thermometers; and, from his experience, he is induced to consider instruments made in his way much superior to the common mercurial thermometer.

The form of the instrument is nearly that of the common thermometer; but the tube is of extreme fineness, a quarter of a grain of mercury occupying in it a length of three, four, and even five inches. In order to blow a ball at the end of such a tube, it is found necessary to attach a condensing syringe to it, the elastic gum bottle not being sufficient for the purpose; and in forcing in the air when the end of the glass has been heated to produce the ball, great care must be taken that no moisture or oil enter the tube, as the smallest particle completely closes up its minute passage.

The ball and tube are then filled with alcohol in the usual manner; and after this is done, the bore of the tube is to be expanded into two small bulbs near to each other, and to what is to be the top of the instrument, or the instrument may be reversed; the ball may be considered the top, and the other extremity being turned round may have the two bulbs blown on it so as to resemble a common form of the barometer; this being done, alcohol is to be introduced, until not only the ball and tube, but the lower bulb, and part of the upper are filled with it.

In these thermometers one object was to avoid the injurious effect occasioned by the adhesion of the surface of the fluid in the tube with the glass; the surface of the fluid is therefore not regarded as any indication of the state of the instrument, it is always in the upper bulb, and is very little altered by any alteration of temperature; but a point is taken in the column of alcohol in the tube, by which to make observations, and this point is marked by a small cylinder of mercury; and in addition to the advantage thus obtained, of perfect freedom of motion, the column which before from its minuteness was with difficulty visible, becomes readily distinguishable at the necessary point. The mercury is readily introduced into the tube of the instrument by warming it, and then introducing its extremity into the metal on cooling; it passes first into the bulbs, and may then be placed in any required part of what is to be the scale, and this being done, the instrument is to be closed and graduated.

In this way thermometers have been made so delicately, that with a ball of three lines and a half in diameter each degree (of Reaumur) has been ten and twelve inches in length, which extension allows of a division to the four hundredth and even the six hundredth part of a degree, without affecting the accuracy of the instrument. In graduating it the principal points may be taken from a mercurial thermometer, and the division into equal parts adopted for the others.

Il C. Landriani enumerates some of the advantages this instrument has over common mercurial thermometers. It is more readily constructed, the adhesion of the mercury to the glass being obviated, and even the adhesion of the surface of the alcohol being of no consequence. Its material, the alcohol, has more fluidity

and expansibility than mercury. In mercurial instruments the weight of the metal endangers the bulb, which, being necessarily thin, is liable to accidents in a much greater degree than when filled with alcohol. Another important defect to which mercurial thermometers are liable, and from which these are very nearly free, is the expansion of the ball at the extremity by the weight of the column of mercury in the tube; and this column, varying with the temperature, and its pressure by position, errors of a very changeable nature are introduced. Thus, with a mercurial thermometer, having a ball of four or five lines in diameter, and degrees four or five lines in length, the temperature indicated is not the same in a vertical and in a horizontal position *.

Il C. Landriani proposes also the use of his instrument in determining fractions of degrees which cannot be observed by the common thermometer. This is done by graduating the instrument into degrees according to common thermometers, but not affixing numbers to them; and then by displacing the mercury from part to part, the scale may be made to commence at any given degree. If the mercury be made to descend into the ball of the instrument, or to rise into the bulb, and the instrument be placed horizontally, the temperature of the whole may then be brought to any required point; and that done, by placing the thermometer vertically with the ball upwards or downwards, as required, the mercury is made to enter the tube, and passes over degrees graduated upwards or downwards from the temperature to which the whole instrument was brought.

20. *New self-registering Thermometer*—M. Landriani in a succeeding number of the *Giornale di Fisica*, has proposed these thermometers to be used in meteorological observations as self-registering thermometers, and they appear very applicable to this purpose. They are to be constructed as before described, except, that besides the cylinder of mercury, which is the indicator of temperature, there is to be another portion of mercury within, either the ball or the first bulb, as the instrument is to measure the extreme point of heat or of cold.

The use is as follows. Supposing it put by, the indicating cylinder of mercury will, of course, be somewhere in the stem, and the other portion of metal should be in the ball; if it be required to mark the lowest degree of cold during the night, it is to be placed upright with the ball upwards, and the point where the indicator stands noted; the mercury in the ball will rest just over the orifice of the tube, and will enter it on any descent of the column beneath; if the temperature diminishes, however, that

* When the column of mercury is long and fine, the difference between the degrees marked in the proper position of the instrument, and when it is inverted, will amount to one and a half, and even two degrees, and in most instruments of this kind it may be observed.

column will ascend, the spirit in the ball contracting; but whenever it begins to expand again, the mercury in the ball will descend, dividing the alcohol above and below it. When the instrument is next observed, therefore, nothing more is required to ascertain the extreme cold of the night than to mark the numbers of degrees between the two cylinders of mercury, and these, subtracted from the numbers of degrees between the indicator, and the ball or the mercury at the first observation, give the degrees of cold.

In ascertaining the extreme heat, M. Landriani proposed to use another thermometer with the ball downward, when the first bulb will become the receptacle for the registering portion of mercury, and the difference between the two columns of alcohol included between the indicator and the bulb at the first observation, and the indicator and registering mercury at the second, will give the extreme heat of the instrument between the two observations.

It would be easy, however, to make one instrument answer both purposes, and one which M. Landriani depicts is very fit for them; the ball is above, and the tube is bent just above the bulbs, so that they shall also stand perpendicularly and rising upwards from the tube. If then a small portion of mercury be appropriated to the ball, and another to the first bulb, the former will indicate the lowest temperature in the absence of the observer, and the latter the highest, the indicator of course always being present.

21. *New Pocket Blow-pipe.*—Captain Bagnold has constructed an instrument of this sort, which is portable, and in its use does not encumber the operator; by means of a screw it can be readily attached to a table or bench, and in this position, whilst the operator obtains an increase of power from the steady direction of the flame, *both* hands are perfectly at liberty to manage the glass or other matter submitted to its action.

The instrument is composed of four parts or joints, viz., a flexible one of leather, (to which is attached a wood or ivory mouth-piece) and three of brass.

The brass parts are made of drawn tube of three successive sizes, so that each can be inserted into the other, moving freely, yet sufficiently air-tight. The first is about three inches long, and quite straight and closed at the bottom, where a sharp double thread screw is fixed, which by worming into the table, or bench, secures it steadily; and about half an inch from the bottom is a lateral opening, into which the flexible tube of one foot long is screwed. The second is composed of two pieces of tube united by a mitre joint, so as to form a rectangle, and, being inserted into the first, affords both extension and horizontal motion. The

third is perfectly similar to the second, into which it is inserted, giving a vertical movement, and to the extremity of this joint, jets of different sizes are adapted. The screw is guarded by a moveable brass cap for the convenience of the pocket.

22. *Specific Gravity of Gases.*—The apparatus necessary for taking the specific gravity of gases by the following method, consists of a delicate balance, or beam, so constructed as to support at each end a bulky vessel. One of these may be a globe or flask, furnished as usual with a stop-cock; the other, of equal size and weight, must be cylindrical, so as to allow of graduation into equal parts; it must have a stop-cock terminating in a minute aperture.

The two vessels, when filled with air and hung on the beam, should exactly balance it. When used, the globe or flask is to be filled with the gas, the specific gravity of which is to be ascertained, and the other is to be exhausted so far as to be the lighter of the two. Being placed on the beam, air is to be let into the cylindrical vessel until it equals the other in weight; it is then to be removed from the beam, and by having its aperture opened under mercury, the air within is reduced in volume until it equal in density to the atmosphere. This reduced volume gives the specific gravity of the gas weighed: thus, supposing the cylinder to have been graduated into 1,000 parts, and that the expanded air within it has been balanced against hydrogen in the other vessel; then, if on opening it under mercury it diminishes to 69.44 parts, 69.44 is the specific gravity of the hydrogen, the air being 1,000.

This form of the apparatus is appropriated to gases lighter than air, but by a slight modification (or the addition of weight) it may be used with heavy gases. It is an ingenious addition to the apparatus of pneumatic chemistry, and obviates some of the disadvantages attached to the old method.—*Thomson's Annals.*

§ 2. Meteorology, &c.

1. *Meteors.*—Vienna. On the last day of October a brilliant meteor was seen at Bucharest, about ten o'clock in the evening. Those who observed it, said it was a globe of fire resembling a falling star, that it slightly elongated itself, and ended in a faint light, which disappeared in two minutes. A courier travelling on the road of Moldavia saw it, and described it as being exactly of the same form and splendour; he was one hundred and twenty miles distant from Bucharest at the time.

A similar appearance was seen, about half past eight in the evening of the same day, in the neighbourhood of the Bath of Hercules, near Mehadia, in the Bannat, towards the south-east, and it is supposed to have resulted from the same meteor.

Papers from Copenhagen describe a meteor as having been seen at Fuhnen, in the south-west, during the night of December

21. It is described as a ball of fire, from which sparks issued for some time.

On the 2d or 3d of February, about half past four o'clock in the afternoon, a meteor was observed in the neighbourhood of Canterbury, in a south-west direction, moving apparently parallel to the earth's surface. It appeared of the colour and size of the rocket, and its altitude was supposed to be not more than a quarter of a mile. A similar, or perhaps the same, meteor was seen about the same time passing over the parish of Beckley, in Sussex.

2. *Aurora Borealis.*—The height of the Aurora Borealis does not appear to have been ascertained with much certainty, and there is still much discrepancy of opinion concerning it. The apparent position of a very splendid phenomenon of that nature, seen in Aberdeenshire, on the evening of the 19th of February, 1819, may, if the same phenomenon was observed, and its position ascertained, about the same hour, at any station considerably to the north or south, furnish data, for obtaining, within certain limits, a rude approximation towards its elevation above the earth.

The place where the following observations were made, is laid down in the best maps, in lat. 57° 11′ N., long. 2° 30′ W. of Greenwich. At this station, the magnificent meteor in question was first seen, about ten minutes past eight o'clock in the evening, forming across the heavens, nearly at right angles to the magnetic meridian, a brilliant zone, or belt, of greenish light, with momentary coruscations, tinged with orange red and violet. It formed a segment of a nearly vertical arch, occupying about 120°, each of its extremities terminating behind clouds, about 30° above the horizon.

The breadth of the zone of light, at its eastern extremity, where it was most vivid was about 4°, and it gradually widened, so as to form a breadth of about 6° at its western extremity, where it was much more attenuated. The breadth varied slightly and momentarily, with the coruscations.

When it was first seen, the *northern edge* of the zone passed about 5° to the southward of the southernmost index star of Ursa Major, β, and the same distance to the southward of the Zenith; it touched Capella in Auriga, and passed about 2° 30′ to the northward of the Pleiades, that constellation appearing in the middle of the zone.

The phenomenon continued visible for about forty minutes after it was first observed, maintaining nearly its position with regard to the earth, and continuing nearly to have the same apparent dimensions, having only moved during that interval 2° or 3° southward, parallel to itself, becoming gradually less luminous, and enlarging its breadth to about 7°; after which it totally disappeared.

Immediately afterwards, the horizon having become partially cleared of clouds, very brilliant auroræ boreales were seen dispersed

along the quarter of the heavens, from west to north, extending from the horizon to an elevation of 30° or 35°, and remained visible for about two hours, when the observations were discontinued.

3. *On coloured Snow and Rain.*—The *Giornale di Fisica*, &c., of November and December, 1818, contains an account and analysis of various showers of coloured rain and snow, from which the following brief collection of facts has been taken :—

A shower of red snow fell in Carniola in the nights of the 5th and 6th of March, 1808.

On the same night, a shower of snow, of a rose colour, fell over the whole surface of Carnia, Cadore, Belluno, and Feltri, to the height of twenty centimetres. The earth was previously covered with snow of a pure white, and the coloured snow was succeeded by other of a pure white, neither were the two kinds mingled together, but remained perfectly distinct even during liquefaction. When a portion of this snow was melted, and the water evaporated, a little finely-divided earth, of a rosy colour, remained not attractable by the magnet, and consisting of silex, alumine, and oxide of iron.

The same phenomenon happened at the same time in the mountains of Valtelline, Brescia, and the Tyrol. This snow was of a red or blood-rose colour, and was underlaid and covered with white snow. Its colour faded gradually until it was dissolved.

On the same evenings of the 5th and 6th of March, 1803, a shower of red snow fell at Pezzo, at the extremity of the Valle Camonica. It was preceded by a very violent wind on the 5th.

On the evening of the 14th and 15th of March, 1813, coloured rain and snow fell over a very large extent of country. Red rain fell in the two Calabrias, and on the opposite part of Abruzzo, the wind being at E. and S. E. Snow and hail of a yellow red colour fell over all Tuscany with a north wind. Red snow fell at Tolmezzo, the wind being at N. E., and in the Carnia Alps; and, finally, snow of a brownish yellow colour fell at Bologna, the wind being S. W.

A pound of this last snow was found to contain three grains of earthy powder. During the evaporation a black substance was deposited, and the water became dirty yellow. The taste of this earthy substance was at first styptic, and then bitter. It deflagrated with nitre, and on being analyzed, gave the following results :—300 gr. were composed of combustible, vegetable, or

animal matter	96
Red oxide of iron	96
Alumine	36
Silex	69
	297

On the 15th of April, 1816, coloured snow again fell in Italy, on Tonal and other mountains; it was of a brick colour, and left an earthy powder, very light and impalpable, unctuous to the touch, of an argillaceous odour, and tasting a little acid, saline, and astringent. These characters agreed with those of the powder left by the coloured snow of March, 1803. This powder analyzed gave the following results:—

Silex	8 gr.
Iron	5
Alumine	3
Lime	1
Carbonic acid	.5
Sulphur	.25
Empyreumetic oil	2
Carbon	2
Water (by reagents)	2
Loss	2.25
	26

Some reflections close this paper in the Italian journal, which are briefly to this effect:—The analyses shew that the colouring matter of these snows differs from the substance of meteoric stones, and cannot be referred to their sources; and that it differs still further from animal matter, originating as has been supposed from minute insects. They shew also that it cannot originate from the soil in the neighbourhood of the place where it falls, which deduction is also confirmed by the circumstance, that the wind is sometimes very violent, and at other times very calm, when the snow falls. The extent of country covered by these showers, as in 1803 and 1813, extending to eight degrees in length and breadth, proves that the cause is not local but very general. These phenomena happen precisely at the time of the spring equinoxes, when impetuous winds are flying about, which originate in very distant countries. These winds, it is supposed, may possibly elevate the sand of distant regions in the air, and may convey the more minute particles to immense distances, and these, adhering to the water of the clouds, at last descend with it, either as hail, snow, or rain, and produce the phenomena under consideration. In this point of view Africa offers an abundant source of these showers, and they have been observed principally in those parts, where on this supposition they might very well have been expected.

A distinction is made between these coloured showers and such as are known to be volcanic; and between the substances that fall, and the curious, but partial, patches sometimes found on mountains, and lately in the north.

4. *Volcanic Island.*—According to letters from Petersburgh, advices had been received there of a new Volcanic Island having

been raised among the Aleutian Islands, not far from Unalaschka. This phenomenon appeared in the midst of a storm, attended with flames and smoke. After the sea was calmed, a boat was sent from Unalaschka, with twenty Russian hunters, who landed on this island, June 1st, 1814. They found it full of crevices and precipices. The surface was cooled to the depth of a few yards, but below that depth it was still hot. No water was found on any part of it. The vapours rising from it were not injurious, and the sea lions had begun to take up their residence on it. Another visit was paid to it in 1815; its height was then diminished. It is about two miles in length; they have given it the name of Boguslaw.

5. *Earthquakes.*—A Pekin Gazette of May 2d, 1817, contains an account of an earthquake which occurred in the preceding April, at a place called Chang-Ruh, on the borders of the province of Szechuen, on the western frontier of China. Above 11,000 houses were thrown down, and more than 2,800 persons killed.

Two earthquakes were felt at Cape Henry, St. Domingo, on November 20th; five persons were killed, and some houses were destroyed.

A shock of an earthquake was felt on December 10th, about eight o'clock in the evening, at Reggio, in the duchy of Modena.

Very violent shocks of an earthquake alarmed the people of Genoa, on the 8th of January, to such a degree, that many fled to the country for safety. The shocks passed from Port Maurice to Saint Romi, which suffered much, but nothing was felt either at Nice or Alassio. Vessels at sea were very much agitated, so that the shock was supposed even much greater there than on land.

Several shocks of an earthquake were felt at St. Ubes, on the 24th and 25th of January last; no lives were lost, nor any damage sustained.

A smart shock of an earthquake was felt at Ballenloan, in Glenlyon, about five o'clock on the evening of the 11th of February. A tremendous gale, and much snow immediately followed it.

III. Natural History.

§ Zoology, Medicine, Geology, &c.

1. *Tapir in Asia.*—A circumstance interesting to zoologists has taken place in the discovery of the Tapir in Asia; one of these animals was observed by M. Diard, in the menagerie of the Marquess

of Hastings, at Calcutta; it had been taken by the people of Sumatra, and sold as an unknown animal. It differed in nothing from the American species, except in colour, which was a brown black on the fore part of the hinder limbs, the body and ears being white. M. Diard, saw also at Calcutta, the skull of an old animal which did not appear to differ from that of the American tapir. It was ascertained that it came from Malacca, and on inquiry it was found to belong to an animal, as common there as the rhinoceros or elephant. The teeth of the animal, and of the skull, seen by M. Diard, agreed exactly with those described by Cuvier, as belonging to the American tapir, and there is every reason to suppose the animal to which they belonged the same.

2. *Organic Remains.*—Whilst cutting the new canal, to join the Brink, in Cambridgeshire, a fine pair of antlers was taken up in a bed of shingles 22 feet below the surface; they were attached to the upper part of the skull in which the teeth were very perfect.

3. *Physiological Prize.*—An anonymous person has transmitted to the Royal Academy of Sciences of Paris, a sum of money for the foundation of a prize in physiology; and in consequence a gold medal of 440 francs value, will be given to the author of the printed work or manuscript sent to the academy before December 1, 1819, which shall be judged to have most contributed to the progress of experimental physiology.

4. *Cow-Pock in India.*—The following account of the cow-pock in Persia, is from a letter written by W. Bruce, esq., resident at Bushire, to W. Erskine, esq. of Bombay, March, 1813.

"When I was in Bombay, I mentioned to you that the cow-pock was well known in Persia, by the Eliaats, or wandering tribes. Since my return here, I have made very particular inquiries on the subject, amongst several different tribes who visit this place in the winter, to sell the produce of their flocks; such as carpets, rugs, butter, cheese, &c. Their flocks during this time are spread over the low country to graze. Every Eliaat that I have spoken to on this head, of at least six or seven different tribes, has uniformly told me, that the people who are employed to milk the cattle caught a disease, which after once having had they were perfectly safe from the small-pox; that this disease was prevalent among the cows and shewed itself particularly on the teats, but that it was more prevalent among, and more frequently caught from the sheep. Now this is a circumstance that has never I believe before been known, and of the truth of it I have not the smallest doubt, as the persons of whom I inquired could have no interest in telling me a falsehood, and it is not likely that every one whom I spoke to should agree in deceiving, for I have asked at least near forty or fifty persons. To be more sure on the subject I made most particular inquiries

of a very respectable farmer who lives about fourteen miles from this, by name, Malalla, aud who is under some obligations to me; this man confirmed every thing that the Eliaats had told me, and further said that the disease was very common all over the country, and that his own sheep often had it. There may be one reason for the Eliaats saying that they caught the infection oftener from the sheep than the cow, which is, that most of the butter, ghee, cheese, *&c.*, is made from sheeps' milk, and that the black cattle yield very little, being more used for draught than any thing else.—*Phil. Mag.*

5. *Animal Calculi and Concretions.*—M. J. L. Lassigne has analyzed several concretions and calculi from different animals with the following results:

A calculus from the bladder of a dog, was composed of urate of ammonia and phosphate of lime; and differs therefore from any calculus from the same animal, noticed by Fourcroy and Vauquelin.

Urinary calculi from an ox were found to be formed of carbonates of lime and magnesia.

Salivary calculus from a cow. It was white, very hard, capable of being polished, and the size of a pigeon's egg; it contained much carbonate of lime, a little phosphate of lime, and a little animal matter.

Concretion from the salivary duct of a hare. It was white, soft, elastic and of the exact form of the canal where it had been formed; it contained an animal substance like mucus, a little albumen, and in its ashes subcarbonate of soda, muriate of soda, and phosphate of lime.

Concretion formed in the brain of a horse. It was white, rather soft, and the size of a nut; it was composed of cholesterine, an albuminous animal matter, and phosphate of lime.

Concretion found in the lungs of a cow, affected by phthysis pulmonalis. These were small white hard grains, united by a mucous matter, and contained phosphate and carbonate of lime.

Concretions from a cyst in the mesentery of a bull, attacked by phthysis. They were like the preceding.

A substance found in a tumour, in the mesocolon of a mare, was yellow, greasy to the feel, and smelling like rancid oil. It contained cholesterine, a substance resembling margaric acid, albumen, a carbonated alkali, with phosphate and carbonate of lime.

6. *Substitute for the Cinchona.*—A new kind of febrifuge bark has been proposed for use in France, an account of which has been published in the *Journal Universel des Sciences Medicales* and the *Nouveau Journal de Médecine.* A specimen has been received from the Isle of Bourbon, by M. Bose, of the Academy of Sciences.

This substance is employed by the negroes of Madagascar, and the Creoles of the other African islands, against the fevers so com-

mon in those southern latitudes. It is administered both internally in decoction, and applied to the temples and hands in the form of powder, moistened with vinegar.

The bark is rolled up like that variety of cinchona cordifolia, which comes from Loxa. Its epidermis is fawn-coloured, and covered in patches, with specks of a yellow farinous matter, but less abundantly than that of the *Angustura ferruginea.* The texture of this epidermis, about one line in thickness, is granular, its taste bitter and aromatic. The more internal part of the bark or liber is of a reddish brown colour, and of a singularly bitter and pepper-like taste, with somewhat of the sweet flavour of liquorice-root. It presents no resinous appearance upon fracture.

The shrub which yields this bark, grows very common in Asia, and the African islands. It was first figured by Van Rheede, in his Hortus Malabaricus, under the name of the *Kaka-Toddali.* From Linnæus and Wildenow it has obtained the respective titles of *Paullinia Asiatica* and *Scopolia Aculeata,* and Jussieu has lately called it *Toddalia,* from the designation which it bears on the coast of Malabar. It is a small prickly, bushy shrub, and may be readily recognised by its flowers in axillary panicles, composed of a calyx, divided into five teeth, corolla pentapetalous; stamina, five; styles, and stigmata, three. The fruit is a berry of the size of a pea, containing five dry oval seeds. It is wrinkled, and full of volatile oil.

The leaves are alternate and dull, and covered like those of the *Hypericum perforatum,* by minute translucid points. They are oval lance-shaped, somewhat serrated, and even, like the stems and branches, with prickles. Hence this shrub belongs to the class Pentandria, and order Trigynia, and to the natural family of *Terebinthaceæ* (of Jussieu) not far from the *brucea*; the astringent bark of which is also febrifuge, and anti-dysenteric. The bark of the root is almost exclusively employed by the negroes.

Dr. Cloquet mentions also a root lately received from Senegal, resembling very much the Toddalia, and used by the inhabitants for a similar purpose. It differs from the Toddalia, in the greater size and strength of its root, but the particular characters of the plant are not known.

7. *Fossil Wood.*—A species of siliceous fossil wood was found by a sergeant of artillery, who accompanied Captain Sabine, near the top of a hill, in Hare Island, on the west coast of Greenland, in latitude 70° 26′. It had been a part of the trunk of a pine tree, about four inches in diameter. The hill is in the interior of the island, about four miles from the shore, and is considerably more than 900 feet above the level of the sea, being higher than an intermediate hill, the elevation of which was ascertained barometrically.

IV. General Literature, &c.

1. *Greek Antiquities in the Crimea.*—Part of a letter from the engineer Von Steer, at the fortress of Fanagoria, in the government of Tauris, formerly the Crimea. Aug. 20, 1818.

Among the curiosities of this place are the remains of antiquities of the time of the Greeks who planted colonies here. In the beginning of this month, in digging up a hill, a stone vault was discovered which contained a corpse, six feet and a half long, in a very good state of preservation. The head was ornamented with a golden garland of laurels, and on the forehead a golden medal, which represents a man's head, with the inscription, *Philip.* On both sides of the corpse stood golden and earthen vessels, as was the custom among the Greeks, also several golden chains and ear-rings, and on one of the fingers was a gold ring with a valuable stone, on which were represented a male and female figure of exquisite workmanship. From all this it may be concluded that this was the burial-place of one of Philip's generals.—*Phil. Mag.*

2. *Antient Tombs.*—The tumuli, called the Chronicle Hills, upon Gott Moor, near Whittlesford, Cambridge, have been lately opened, and, from appearances, are supposed to be Celtic rather than Roman tombs. Upon opening them, four skeletons, which were found lying on their backs, were removed from the larger one, and also some broken pieces of terra cotta, with red and black glazing.

About one hundred yards distant two other sepulchres were found and opened; they contained skeletons in soroi, constructed of flints, pebbles, *&c.* In the first soros, which was five feet square and eight feet deep, were found two skeletons. The uppermost appeared to be the larger; the blade of a poinard or knife was found under the skull, which rested upon the body of the other. The soros was full of dirt, and patches of a white unctuous substance, like spermaceti, adhered to the flints. It had an oak bottom, black, but here and there stained green, from the corrosion of an antient bronze vessel. Large iron nails were also found, but much corroded. In the other soros, which was only four feet square, but eight deep, a human skeleton was found, and another below it, in a sitting posture, with an erect spear, the point of which was iron. Nails were found here, but no wood.

Abundance of small quadruped bones were found here, which are supposed to have belonged to a kind of lemming once existing in this country, but now not known in it.—See *Gents. Mag.*

3. *Fasti Consulares.*—A new fragment of the *Fasti Consulares* has been discovered at Rome, in the neighbourhood of the temple of Castor and Pollux. It is composed of seventeen lines, and

relates to the second Punic War, which, it is expected, will be much illustrated by it.

The first volume of a collection of these fragments has been published at Milan. Signor Bartolomeo Borghesi, the editor, proposes to illustrate and arrange the whole of them, and the work is expected to form three volumes, quarto.

4. *Ancient Town in Egypt.*—An ancient city has been discovered in the mountains, about nine hours' journey from the Red Sea, between 24° and 25° of latitude. There are still above 800 houses remaining, and among the ruins are found various temples. There are eleven statues, and the fragments of others. The French traveller who discovered this place, has also ascertained the ancient stations that were appointed on the route through the desert, going from the Red Sea to the Valley of the Nile. They are at distances of nine hours from each other.—(*Revue Encyclopédique.*)

5. *Antiquities at Arles.*—A very elegant ancient vase, three feet high, with a number of funeral urns, lacrymatores, earthen lamp, coins, a large fragment of architecture, and a medal struck to commemorate the marriage of Constantine, have been found at Arles, on the banks of the Rhone. Excavations are now making for the discovery of other antiquities.

6. *Ancient Bridge.*—A stone has been taken up lately, in the Rhine, from one of the piles of an ancient bridge, on the side of Cassel. It was four feet long and two wide, having for an inscription *LEG. XXII.* It is judged probable, therefore, that the bridge has been built by the 22d Roman Legion, which is known to have come from Syria to Mentz, sixty-nine years after the birth of Christ.

7. *Scientific Excursion in America.*—A scientific excursion is proposed up the Mississippi, and its tributary streams, by a party of persons, who have built a steam boat at Pittsburg for the purpose. It is intended to set out immediately, and not less than three years are appointed for the purpose.

8. *Skin of the Rhinoceros.*—It appears from some experiments made lately in India, that the skin of the Rhinoceros will resist a musket-shot, though fired from a piece at a short distance only. These experiments were made on the body of an individual, which had been of great size and very old. It was killed near Givalpara, on the borders of the Asam country. The number of them in these parts is immense. The Bourampouter is sometimes so covered by them, that, though nearly a league across, the smallest vessel cannot find room to pass.—*Annales de Chimie.*

9. *State of the Population of Paris for* 1817.

BIRTHS.

At Home,	legitimate,	Boys,	7,395	14,423
		Girls,	7,028	
	illegitimate,	Boys,	2,216	4,429
		Girls,	2,213	
At the Hospitals,	legitimate,	Boys,	148	289
		Girls,	141	
	illegitimate,	Boys,	2,360	4,618
		Girls,	2,258	
	Total of births,	Boys,	12,119	
		Girls,	11,640	
Natural Children,	acknowledged,	Boys,	1,073	9,047
		Girls,	1,037	
	abandoned,	Boys,	3,503	
		Girls,	3,434	

DEATHS.

At Home,	Males,	5,805	21,124
	Females,	6,379	
At the Hospitals,	Males,	3,911	
	Females,	4,072	
French Military,		602	
In the Prisons,		83	
Deposited at the Morgue,		272	

MARRIAGES.

Bachelors and Maids,	5,171	6,382
Bachelors and Widows,	355	
Widowers and Maids	605	
Widowers and Widows	251	

These tables are from the *Annales de Chimie*, and were furnished by the Prefect of the Department at the Bureau des Longitudes. They differ from those published in the *Journal de Pharmacie*, the number of deaths there given surpassing the number here by 262.

The number of deaths from the small-pox were, in 1817, 740, according to the *Annales de Chimie*, and in which the ages are enumerated; but the *Journal de Pharmacie* gives the number at 486.

The number of ascertained suicides, in 1817, was 197; and of the 272 deposited at the Morgue, probably one half may be added to these.

10. *General Population and Territory.*—The table of population and territory of the present civilized world, as lately exhibited, gives to China 200,000,000, and 1, 200,000 square miles of

territory; to Great Britain 20,000,000 of population, and 100,000 square miles; and to the United States 10,000,000, and 2,500,000 miles; and the total of the whole world is, of population 435,800,000, and of territory 9,687,000 square miles; so that the United States have the largest home territory of all the nations except Russia. China is not included in this, because it contains many parts barbarous and helpless. Britain possesses 150,000,000 of subjects in her colonial empire, and posseses a dominion equal to nearly one-fifth of the whole surface of the globe.

11. *Prizes offered in France.*—The Society for Encouragement of National Industry in France have offered the following prizes: improved manufacture of sewing needles, 3,000 francs; dressing of flax and hemp without soaking, 1,500 francs; new method of silvering the back of mirrors, 2,400 francs; dyeing wool scarlet by madder without cochineal; for artificial diamonds and precious stones, 1,200 francs; preservation of alimentary substances according to M. Appert's process, 2,000 francs; best mode of salting provisions, 2,000 francs; construction of a country windmill, 4,000 francs; for planting the Northern pine, 1,000 francs; for planting the Scotch pine, 1,000 francs. These have been offered before, and are not yet merited.

The following are other prizes:—for the completion and perfection of the *moria*, (a machine for raising water,) 1,000 francs; for the construction of a new water-wheel, 3,000 francs; a mill for cleaning Indian corn, 600 francs; for the establishment of wells for obtaining water by filtration, two prizes, 1,500 francs and 3,000 francs; preparation of materials adapted to the arts of engraving, 1,500 francs; a substance that may be cast in a mould like plaster of Paris, and of greater durability, 2,000 francs; manufacture of Russia leather, two prizes, 1,500 francs and 3,000 francs; to the maker of the hydraulic press, that shall have been substituted for the common presses of oil and wine, 2,000 francs.

The amount of prizes offered by this Society for the Encouragement of the Arts amounts to 76,600 francs.

12. *George Bidder,—Zerah Colburn.*—George Bidder of Morton, Hampsted, who possesses such ready and surprising powers of calculating, is at present in London. It is perhaps not generally known, that he asserts the ability of communicating his method to others, and of enabling them to perform the same things as himself. Zerah Colburn also made the same statement; and from the developement of part of his method, there is no doubt it can be done, but it would require an excellent memory, and probably would not be very generally applicable to use. To mathematicians, engineers, and others, however, it would present great advantages; and it should be known, that both George Bidder, and Zerah Colburn, have offered to disclose their methods, on condition that they be remunerated in a respectable manner.

Art. XXII. METEOROLOGICAL DIARY for the Months of December, 1818, January and February, 1819, kept at Earl Spencer's Seat at Althorp, in Northamptonshire. The Thermometer hangs in a north-eastern aspect, about five feet from the ground, and a foot from the wall.

For December, 1818.

		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Tuesday	1	47	48	29,88	29,80	SW	S
Wednesday	2	37	45	29,85	29,81	SbW	SW
Thursday	3	35	47	29,48	29,31	S	SE
Friday	4	41	48	29,31	29,38	SE	S
Saturday	5	39	49	29,40	29,32	SE	SE
Sunday	6	36	48	29,42	29,40	SE	SE
Monday	7	31	48	29,20	29,37	W	SW
Tuesday	8	32	49	29,55	29,77	SE	WbS
Wednesday	9	29	40	29,91	29,96	NE	NE
Thursday	10	37	44	30,07	30,08	NE	N
Friday	11	34	41	30,07	30,10	NbE	NbE
Saturday	12	33	41	30,16	30,08	NE	NE
Sunday	13	37	42	30,09	30,10	NE	NE
Monday	14	36	41	30,10	30,12	NE	N
Tuesday	15	36	39	30,09	29,94	NbE	NE
Wednesday	16	24	30	29,90	29,98	NE	NE
Thursday	17	20	33	30,00	29,90	W	SW
Friday	18	27	39	29,70	29,83	SW	NW
Saturday	19	27	36	30,10	30,10	W	SSW
Sunday	20	35	47	29,95	29,85	SW	SW
Monday	21	42	45	30,00	30,20	WbS	WbN
Tuesday	22	24	37	30,39	30,39	WbN	NE
Wednesday	23	26	36	30,37	30,25	NE	WbN
Thursday	24	28	31	30,19	30,13	SW	SE
Friday	25	26	38	30,09	29,93	SW	SE
Saturday	26	32	34	29,80	29,80	SE	S
Sunday	27	35	40	30,00	30,17	SE	NE
Monday	28	34	39	30,40	30,50	NE	NE
Tuesday	29	26	36	30,56	30,56	NE	NW
Wednesday	30	25	33	30,42	30,40	WbN	W
Thursday	31	27	35	30,37	30,37	W	W

For January, 1819.

		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Friday	1	25	33	30,40	30,40	W	W
Saturday	2	24	36	30,40	30,36	WbN	SW
Sunday	3	35	38	30,28	30,20	S	S
Monday	4	36	40	30,12	30,10	SE	SE
Tuesday	5	37	43	30,10	30,13	SW	SSW
Wednesday	6	27	42	30,19	30,05	SW	S
Thursday	7	32	44	29,74	29,60	SE	SE
Friday	8	33	46	29,78	29,70	W	SW
Saturday	9	35	49	29,42	29,39	WSW	S
Sunday	10	38	50	29,74	29,47	S	SSW
Monday	11	39	42	29,60	29,60	SbW	WSW
Tuesday	12	33	46	30,00	30,00	WSW	SW
Wednesday	13	37	48	29,87	29,87	SW	SW
Thursday	14	34	52	29,75	29,70	WSW	WbS
Friday	15	37	48	29,83	29,70	WbS	WbS
Saturday	16	33	41	30,10	30,11	W	WSW
Sunday	17	35	47	29,27	29,18	W	W
Monday	18	37	41	29,30	29,53	W	W
Tuesday	19	33	40	29,69	29,59	W	SSW
Wednesday	20	32	37	29,46	29,40	W	SW
Thursday	21	33	40	29,25	29,40	W	W
Friday	22	32	46	29,40	29,13	W	SW
Saturday	23	33	39	29,48	29,60	SW	SW
Sunday	24	32	45	29,46	29,25	SE	SE
Monday	25	33	43	29,39	29,02	S	SW
Tuesday	26	31	39	29,31	29,37	SW	SW
Wednesday	27	33	43	29,28	29,38	E	EbN
Thursday	28	37	48	29,28	29,28	EbN	SE
Friday	29	29	43	29,40	29,40	SE	SE
Saturday	30	33	40	29,30	29,30	NE	NE
Sunday	31	35	39	29,42	29,48	NNE	NE

For February, 1819.

		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Monday	1	25	35	29,50	29,47	W	SW
Tuesday	2	32	35	29,40	29,53	W	W
Wednesday	3	30	34	29,60	29,40	S	SE
Thursday	4	32	40	29,38	29,60	W	WbN
Friday	5	30	42	29,60	29,49	SE	W
Saturday	6	39	47	29,47	29,40	WbS	WbS
Sunday	7	34	43	29,30	29,40	WbS	W
Monday	8	33	44	29,60	29,78	W	W
Tuesday	9	34	50	29,75	29,60	WbS	S
Wednesday	10	43	46	29,51	29,80	WSW	W
Thursday	11	37	50	29,80	29,78	W	SW
Friday	12	44	46	29,53	29,41	WbS	W
Saturday	13	33	44	29,61	29,61	WbS	WbS
Sunday	14	29	39	29,87	29,91	NW	W
Monday	15	26	44	29,90	29,70	W	SW
Tuesday	16	39	40	29,49	29,30	S	S
Wednesday	17	42	49	29,22	29,40	SW	SW
Thursday	18	38	47	29,40	29,44	WbN	SSE
Friday	19	36	48	29,08	29,24	S	WbS
Saturday	20	31	46	29,68	29,70	W	S
Sunday	21	39	45	28,98	28,89	WSW	NW
Monday	22	37	43	29,65	29,79	NNW	WbN
Tuesday	23	34	39	29,50	29,50	SE	W
Wednesday	24	30	36	29,42	29,46	W	NW
Thursday	25	19	38	29,70	29,75	NW	NW
Friday	26	28	36	29,57	29,40	W	ESE
Saturday	27	33	42	29,30	29,28	SE	SE
Sunday	28	34	41	29,24	29,24	SE	ESS

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THE

QUARTERLY JOURNAL,

July 1819.

ART. I. *An Introductory Discourse, delivered in the Amphitheatre of the London Institution, on Wednesday, the 5th of May,* 1819. *By* William Thomas Brande, *Sec. R. S. and Professor of Chemistry in the Royal Institution of Great Britain.*

I HAVE been honoured by the request of the Board of Management of this Institution, to deliver a course of lectures on the Principles of Chemical Science; and, highly as I am flattered by the distinction which they have thus deemed it right to confer upon me, I should feel uneasy and embarrassed, were I not, on this occasion, and at the very threshold of my undertaking, to assure you that I have acquiesced in their wish, under the impression of considerable diffidence, and a somewhat painful anxiety; that I had hoped and expected that a task so arduous and important, would have devolved upon an abler Professor, and would have been consigned to one of more eloquence and ability than the very humble individual who now stands before you, to plead the cause of science. I should, indeed, have altogether declined the office, and shrunk from its responsibility, had not experience already convinced me that candour and kindness would be the prevalent feeling of my audience, and that they would dispense these in direct proportion to my wants, if they find my exertions unremitting; my zeal unextinguishable; and my desire, limited only by my power to excel.

Under these impressions, I enter upon my design, not with fear and trembling, but with confidence and alacrity; rejoicing in the opportunity of shewing my zeal in the cause in which we are em-

barking; and of conducting you, to the best of my abilities, into the enchanting realms of experimental science.

On account of many circumstances, which it is quite unnecessary to recur to, no attempt will be made, during the present season, to institute a regular series of philosophical or scientific instruction; to speak the truth, our means are inadequate to such an undertaking; our forces are scattered, and it will require time, and skill, and exertion, to marshal them into order, and to bring them, duly equipped, into the field: indeed, it is to the unremitting zeal and activity of your Board of Management, that such arrangements, in respect to apparatus and assistants, have been made, as enable me, upon the present occasion, to open my course with the most ample confidence that nothing will ever be wanting on their part, to furnish such auxiliaries and supplies with a liberal and discerning hand.

As chemical science will form a feature, and, I trust, a prominent one, of the various courses of information and instruction, that are to issue from this room, it shall be my earnest endeavour to lay before you, in simple, but perspicuous terms, the leading objects of that important and beautiful department of physical knowledge; to make you acquainted with some of its already atchieved conquests in the dominion of nature; and to expose some of the probable results of its future progress; and I propose to fulfil these intentions by an experimental inquiry into the powers and properties with which matter is endowed, and which, as it were, preside over its chemical energies, causing, modifying, or preventing them. These, I hope, will soon be rendered familiar to you under the heads of attraction, heat, and electricity, for such these powers are.

It shall be my great object to accomplish these ends in the most clear and perspicuous manner; to divest those branches of science that I am to deal with, of all abstruse and recondite terms; to destroy the fortification of hard words and hidden meanings with which they are sometimes surrounded; and to shew that they may really be brought home to the business and bosoms of men.

But, before I proceed to any further remarks, or expatiate upon the particular objects and ends of my own department of know-

ledge, it becomes me to remember, that we are to-day, for the first time assembled within these walls, to pay our tribute to literature and science at large; that the doors are opened to every range of scientific inquiry, and classical erudition; to every attainment which can expand, embellish, and improve the mind of man. Under these circumstances, I say, it becomes me to speak in more general terms; and I shall, therefore, endeavour to set forth a few of the advantages that society may expect to derive from this munificent establishment; to shew how far it merits your patronage; and to convince you that, in the work we are undertaking, regard is not merely to be had to its immediate consequences, but that we are to consider its influence upon aftertimes, and to look to the benefits that it is to diffuse upon generations yet to come. And I am convinced that I shall be able to shew, that in establishing this Institution in the heart of the city of London, you have done a great and glorious deed for posterity; you have opened a fountain which will never be dried up, but will continue to flow into, and fructify, the commonwealth of science for ages yet to come.

The projectors of this Institution deserve our first thanks; they have shewn the fallacy of the opinion entertained by the greatest political philosophers; and have demonstrated, that high commercial rank and wealth are not incompatible with enlarged minds, liberal views, and cultivated understandings. We are told that, considering the mercantile eminence of their country, and persuaded that whatever increases the splendour, increases equally the strength and activity of commerce, they thought it due to the dignity and glory of the empire, that her commercial metropolis should be graced by a literary and scientific Institution, on a liberal and extensive plan. They judged, and wisely did they judge, that such an establishment would make commerce acquainted with science; and that, by their approximation, each would draw forth and invigorate whatever there might be of latent energy and power in the other. We accordingly find that, under this liberal and creditable feeling, they submitted their views to the consideration of their fellow-citizens, and solicited their co-operation; that their design was universally approved, and that a subscription

of considerable amount was almost immediately raised within the walls of our city.

Such was the auspicious beginning of this establishment. A portion of land was then purchased, and on the 4th of November, 1815, the first stone of the building in which we are now assembled was lowered into its place by the Mayor of London. As the building advanced, its growing wants were met with proportionate liberality, and a magnificent library and amphitheatre, with their various auxiliary apartments, have been at length brought under the same roof, constituting one of the noblest ornaments of the city of London.

I shall first ask your permission to dilate somewhat upon the immediate advantages and benefits which may reasonably be expected to result from this undertaking, and to crown the splendid exertions of its founders and patrons; let us here, however, pause for a moment, to express our earnest wish and humble hope that the great Disposer of events may approve of the motives of this assembly; that His blessing may rest upon the work; that He may render it, in our hands, subservient to the great and disinterested purposes of extensive utility, which it is its sole object to attain; and that in future times this edifice may be the glory of our children's children; that commerce and science may here be entwined in perpetual friendship, uniting their strength for the glory of the empire, the stability of the throne, the perpetuity of our glorious constitution, and the prosperity of the people at large.

The intimate union that subsists between science and commerce, and between literature and the arts; the individual, and, therefore, the public improvement to which this union tends; its influence in elevating, in the rank of nations, the countries that are blessed by its happy influence, are truths inculcated by our knowledge of the world, and with illustrations of which every page of history teems. But history also records the downfall and degradation of learning; she shews us that, where Science and the Arts once flourished in all their vigour, and grew, as it were, in a native soil, they subsequently withered and decayed, leaving little else behind than a few solitary relics, which, like the ruins of some great

edifice or temple, in the midst of a barren plain, tell us that magnificence once dwelt, where we now see nothing but sterility and desolation. Such are the truths recorded by the unerring pen of history, which has shown that even when knowledge and taste had been interwoven with the very manners and habits of a people, and disseminated amongst large and prosperous nations, frequent instances have occurred of their utter loss and obliteration; insomuch that their very existence would be problematical, were it not for the undeniable proofs, which they have left of their former excellence, and which, measured by the powers and capacities of succeeding ages, appear like the productions of a superior race of beings.

Thus, as one of our poets has beautifully expresssed it, "the dawn of human improvement seems to have smiled upon that fabric which it was ultimately to destroy, as the morning sun gilds and beautifies those masses of frost-work, which are destined to vanish before its meridian splendour."

Reasoning upon these things, historians have sometimes gloomily denounced those happy emotions which a nation rising to eminence is apt to produce in a liberal and humane mind: they have talked to us of the declension of our natural energies, and have told us, that all our struggles and exertions, though tending to temporary splendour, will ultimately be involved in a desolate abyss; that the productions of age, can stand in no competition with the vigorous sallies of youth. From the days of Homer, this has been the burthen of the poet's song, and the opinion has, in many cases, received the deliberate sanction of the philosopher. Adverting to this subject, a late eloquent writer* has observed, that although opinions mostly obtain credit by their antiquity, this opinion, in particular, derives no advantage from that circumstance; on the contrary, that very antiquity is the most decisive proof that it is wholly unfounded. If, says he, the human race had declined from its pristine vigour between the period of the Trojan war and the time of Homer, to what a degree of imbecility must it have fallen in the reign of Augus-

* Mr. Roscoe.

tus. "And if, in like manner, the complaint of the Roman poets, of the deterioration of the human race be well founded, to what a miserable state of degradation must it before this time have been reduced. After so long a descent, is it possible that nature could still have produced a Dante or an Ariosto, a Corneille or a Racine, a Shakspeare or a Milton; names which amply show that her vigour is not exhausted, but that she still continues to bring forth the fruits of the mind no less than those of the earth?"

If we ascend from poetry to those nobler and more divine energies of the human mind which are employed in the search after truth; in removing the film from the intellectual eye of man; in developing the mechanism of nature by experimental research; we have only to mention the names of Kepler, Galileo, and Copernicus; of Boyle, Bacon, Newton, and Hooke, to show, that here nature has neither retrograded, nor remained stationary. It is folly, therefore, to assert, that the golden age has passed away, and that man is suffering corporeal and intellectual degradation. On the contrary, let us hope, that if not baffled by its own perverseness, the human race is really tending, in regular and progressive course, towards improvement, and that every age of the world is more enlightened than that which preceded it. We know that history does not exactly bear us out in these hopes, but we shall presently be able to trace the cause of such disappointment, and to calculate upon the probability of its continuance.

Among the causes that have contributed to those vicissitudes of the human energies of which we have been speaking, some have, I think, ignorantly adduced local situation and climate; but let us remember one contradictory instance only, and it will be sufficient to confute such a notion. "Let us remember that the Greeks rose from the very dregs of barbarism till they became the masters of the world, and that that very Greece which was so long the garden of Europe, afterwards became a sterile desert. Bœotia lay in the vicinity of Attica, and consequently enjoyed the same climate; yet were the Bœotians as dull as the Athenians were acute. The splendour too of Grecian science was diffused not only through Greece itself, but extended to colonies far dis-

tant from the metropolis, and very different with respect to climate*."

There are writers who have told us, that there is a tide in the arts and sciences which always tends to their elevation and declension; and further, that when they come to perfection in any state, they necessarily decline, and seldom or never revive in that nation where they had formerly flourished. To the general truth of these remarks, history and experience oblige us to assent; but, instead of resting content with the fact, and acquiescing in its necessity, let us endeavour to trace it up to its cause, and to ascertain whether such fluctuations are really ordained by nature, or whether they arise from the untoward propensities of man.

In thus viewing the subject, it will presently be apparent, that there are direct and immediate causes for that obliteration and declension of science and art that we have just adverted to; that it has always been indicative of a degradation in the moral character of the people; characteristic of declining liberty, and of overwhelming oppression; of the rise of despotism, and the fall of freedom: That wherever these causes have co-operated, the best feelings and energies of the human mind have been blasted; effeminacy and indolence have slided into the place of manliness and activity; vice has gained the ascendancy over virtue; and all that is estimable in the human character, all social virtues and public spirit, have dwindled into selfishness and deceit. It is then to public morals and public liberty that we are to look up as the shield and helmet of the arts and sciences, and as constituting the anchor of their salvation. Under a jealous and suspicious government, be it republican or monarchical, the faculties and energies of the people are palsied and frozen up. Under a free constitution, the mind is neither agitated by apprehension, nor deadened by jealousy and suspicion; freedom of inquiry and of expression are interwoven with its very existence, and all the noblest characters of man shoot forth with vigour and blossom in security.

In the inaugural oration which was spoken by the eloquent and learned Counsel to this Institution, at the ceremony of its foundation,

* See the Abbé Andres, as quoted in Mr. Roscoe's Discourse, delivered at the opening of the Liverpool Royal Institution.

these principles were well illustrated, by directing our attention to the spacious provinces which now compose the Ottoman empire, but which once were the seat of science and of commerce. Then were they dignified by wisdom and valour, and were the fairest portion of the Christian world. But when the tyranny of their invaders deprived them of these inestimable blessings, no tongue can adequately describe the sad and melancholy reverse. Large territories dispeopled, goodly cities made desolate, sumptuous buildings become ruins, glorious temples subverted or prostituted; true religion discountenanced and oppressed; all nobility extinguished; violence and rapine exulting over all, and leaving no security except to abject minds and neglected poverty. Such is the state of a country without religion, and morals, and freedom: Would you behold a country in possession of them, look to your own; contemplate the number and magnificence of her cities, the high state of her agriculture, the activity of her manufactures, the easy intercourse between all parts of the nation; her grand foundations both for learning and charity; the graceful dignity and conciliating ease of high life; the importance and respectability of the middle ranks; the industry and intelligence of the lower; the general veneration of the constitution; the general obedience to the law; the general devotion to their country.—Such is Britain. If it be inquired by what means she has attained this height of glory and prosperity, we must refer it, under the blessings of Providence, to our intellectual liberty, to the respect in which morality and religion are held by the public; and lastly, to that happy union of science and commerce, for which, in every part of her history, she has been eminently distinguished.

If from the earlier we descend to more recent times, to the period which has elapsed since the revival of letters, and which followed that melancholy chasm in the intellectual and moral history of man, commonly called the middle ages, we shall find, that here also the same great truth is inculcated, the same relationship exhibited between ignorance and prejudice, and vice and slavery; between freedom and independence on the one hand, and every quality which adorns the intellectual capacity of man, on the other.

Towards the beginning of the 15th century, we discern the germs

of those innovations which tended to the revival of letters in Europe; the landscape began to re-appear, after the inundation of barbarism with which it had been overwhelmed for the protracted period of nearly a thousand years, and various circumstances co-operated to give a new impulse and activity to causes which had long lain dormant, "for in no one age, from its commencement to its close, does the continuity of knowledge seem to have been entirely interrupted; there was always a faint twilight, like that auspicious gleam which in a summer night fills up the interval between the setting and rising sun." These causes have been so admirably summed up by Dr. Robertson, in his View of the Progress of Society in Europe, from the subversion of the Roman Empire to the beginning of the 16th century, that I shall not attempt either to abridge or recapitulate them. The revival of letters was followed by the Protestant reformation, and by the invention of printing. The former encouraged a freedom of inquiry into religious matters, which diffused a congenial liberality of sentiment over other subjects of investigation; in philosophy it tended to dispel the trifling cavillings of Aristotle concerning matter, form, motion, and time; and it gradually led to the substitution of reason for habit, as a governing principle.

The invention of printing was also attended with most important effects upon the human mind. For us, says an elegant writer upon this subject*, who have been accustomed from our infancy to the use of books, it is not easy to form an adequate idea of the disadvantages which those laboured under, who had to acquire the whole of their knowledge from universities and schools; blindly devoted, as the generality of students must then have been to the peculiar opinions of the teacher who first unfolded to their curiosity the treasures of literature and the wonders of science. Thus, error was perpetuated, and instead of yielding to time, acquired additional influence in each successive generation. In modern times, however, this influence of names is at an end. The object of a public teacher is no longer to

* See Mr. Dugald Stewart's Dissertation, prefixed to the *Supplement to the Encyclopædia Britannica.*

inculcate a particular system of dogmas, but to prepare his pupils for exercising their own judgments. There is another circumstance which also especially merits attention, namely, the influence of the foregoing causes in encouraging among authors the practice of addressing the multitude in their own vernacular tongues. To the zeal of the reformers we owe this invaluable innovation; the sacred books were in almost all the kingdoms and states of Europe, translated into the language of each respective people, and from that moment the prejudice began to vanish which had so long confounded knowledge with erudition, and a revolution commenced in the republic of letters analogous to what the invention of gunpowder produced in the art of war. "All the splendid distinctions of mankind;" as the champion and flower of chivalry indignantly exclaimed, "were thereby thrown down, and the naked shepherd levelled with the knight clad in steel."

I have now, I trust, adduced sufficient evidence to prove the active causes that tend to the progress and welfare of literature, science, and art; to these we are to look, as the sources of those glorious conquests which were made in Europe within two centuries after the revival of letters; and it was under such auspicious influence, that in the reign of Elizabeth, the English mind put forth those unrivalled energies that conduce to the enthusiastic reverence with which we mention the names of Spenser, of Shakspeare, and of Milton,

> Whither, as to their fountain, other stars
> Repair, and in their turns draw golden light:

and which, concentered in Bacon, stamp him as the greatest, most universal, and most eloquent of philosophers; whose doctrines, compared with the subtleties of the schools, are as the noon-day sun, to the transitory meteors that float in the earth's atmosphere.

From these considerations, I am conducted to the second object of this Introductory Discourse, in which I am to endeavour to show the intimate union that subsists between the scientific and commercial interests of a country, and especially of Great Britain.

To shew the necessary connexion that subsists between the progress of the sciences and that of the useful arts, and between commerce and intellectual improvement, will, I trust, become one of the leading objects of public instruction in this Amphitheatre; for it will not only stimulate to exertion by the flattering picture of human ability and resources which it displays, but will also show how much the happiness and perfection of our nature is concerned in the exercise of our relative and social feelings; how nearly our interests are connected where they often appear widest apart. The philosopher, says Dr. Johnson, may very justly be delighted with the extent of his views, and the artificer with the readiness of his hands; but let the one remember, that without mechanical performances, refined speculation is an empty dream; and the other, that without theoretical reasoning, dexterity is little more than a brute instinct. It is, says he, pleasing to contemplate a manufacture, rising gradually from its first mean state, by the successive labours of innumerable minds; to consider the first hollow trunk of an oak, in which, perhaps, the shepherd could scarce venture to cross a brook swelled with a shower, enlarged at last into a ship of war, attacking fortresses, terrifying nations, setting storms and billows at defiance, and visiting the remotest parts of the globe. And it might dispose us to a kinder regard for the labours of one another, if we were to consider from what unpromising beginnings the most useful productions of art have probably arisen. Who, when he saw the first sand or ashes, by a casual intenseness of heat, melted into a metalline form, rugged with excrescencies, and clouded with impurities, would have imagined that in this shapeless lump lay concealed so many conveniencies of life as would in time constitute a great part of the happiness of the world? Yet, by some such fortuitous liquefaction was mankind taught to procure a body at once in a high degree solid and transparent, which might admit the light of the sun, and exclude the violence of the wind; which might extend the sight of the philosopher to new ranges of existence, and charm him at one time with the unbounded extent of the material creation, and at another with the endless subordi-

nation of animal life; and, what is yet of more importance, might supply the decays of nature, and succour old age with subsidiary sight. Thus was the first artificer in glass employed, though without his own knowledge or expectation. He was facilitating and prolonging the enjoyment of light, enlarging the avenues of science, and conferring the highest and most lasting pleasures; he was enabling the student to contemplate nature, and the beauty to behold herself.

It would be easy to trace other arts, and other manufactures, to their recondite and remote sources, and to display the most unexpected and important events springing from trifling causes, and of an apparently undignified origin. To shew in the interwoven boughs of the grove; and the rude attempts of unlettered nations, the elements of Gothic and Grecian architecture. To discover the simple clothing of rude and barbarous countries, composed of the barks of trees and skins of animals, gradually merging into more and more complicated manufactures, in which usefulness and comfort are blended with beauty and elegance; to exhibit the simplest methods of reckoning time, the hour-glass, or the graduated candle, slowly leading to the pendulum-clock, and chronometer.

In all the arts, and in every branch of science, there has been the same slow, yet certain, progress; and in tracing their gradual progression, we shall ever find it most rapid and complete in those countries where commerce and her attendants thrive and are cherished.

Under the influence of commerce, the barren islands of Venice gradually became the seats of wealth and magnificence, and the abode of literature, science, and the fine arts; and it will, perhaps, be remembered by many present, that, in his Inaugural Oration already quoted, your learned Counsel pointed the attention of his hearers to the splendour of the towns of Belgium, to their numerous public edifices of exquisite and costly architecture, and to the numberless paintings, and works in marble, gold, silver, iron, and bronze, with which they abound; and desiring us to recollect that, during a period of about two hundred years, all these cities have been in a declining state, reminded us of what they were in

the sunshine of their prosperity. He told us, and truly too, that the fostering hand of commerce collected all these treasures. For, said he, till the imprudent conduct of the Dukes of Burgundy, and of the house of Austria, drove commerce to Amsterdam, the Netherlands were her favourite seat; and all these monuments of art and science owe their existence to the commercial acquisitions, and well-directed munificence of the burghers of Bruges, Ghent, Antwerp, Brussels, and Louvaine.

With the commercial history of our own country, my audience cannot but be well acquainted. To point out the benefits flowing from its commercial aggrandizement would, indeed, be a pleasing labour, full of substantial and solid gratification, but we need only look around us, and every object that meets our eye proclaims the debt that is due to commerce; the very walls that surround us speak, and tell us that they were raised by her for the protection of science. But the amount of this debt is rendered most obvious by considering our own country in its natural aspect, without any of the benefits and advantages of commerce, and we then presently discern, that without her, science would have been debarred of all her essential aids; she brings to our marts the produce of every climate; converts our tin into gold, and our wool into rubies. "I have often fancied," says Addison, in one of his essays on the benefits of commerce, "when I have been upon 'Change, one of our old kings standing in person where he is represented in effigy, and looking down upon the wealthy concourse of people with which that place is every day filled. In this case, how would he be surprised to hear all the languages of Europe spoken in this little spot of his former dominions, and to see so many private men, who, in his time, would have been the vassals of some powerful baron, negotiating like Princes, for greater sums of money than were formerly to be met with in the royal treasury."

While we are thus contemplating the means and power of commerce, and reflecting upon the liberal aid which science has received at her hands, let us not be unmindful of what remains to be done; let us hope that the acquaintance thus auspiciously

begun, may advance to intimacy, friendship, and regard; and that the mural crown of our city, already the emblem of dominion and strength, may embrace within its protecting circle the interests of science, and become adorned by the rays of intellectual light.

If commerce has, in many instances, munificently contributed to the promotion of science, science has, on the other hand, rendered liberal and essential service to our commercial interests; and of the various branches of science, chemistry stands, in this respect, foremost in the first rank; so important, indeed, is it to the progress of society, that no people ever attained any considerable degree of civilization, independent of the chemical arts. The steam engine is generally and universally allowed as the most noble and effective present ever made by philosophy to the arts: and, considered in the abstract, it is indeed singularly calculated to excite our admiration and surprise; but when we carry our eye from the simple instrument, to its applications, and when we view the numerous branches of manufacture that depend upon it as their prime mover, the understanding is scarcely capacious enough to grasp them, and wants power to do homage to those by whose skill and industry this machine was perfected, and tamed, as it were, into submission. Let me recommend those who complain of the introduction of machinery into our manufactures, and whose clamours are loud against this substitute for manual labour, to reflect upon the state we should have been in without it. One of two things must, in that case, have happened. Either our fields must have been overrun by invaders, and our importance in the scale of nations degraded into something worse than nonentity, while those who have so gloriously defended us abroad were busied at home at the loom and the distaff; or our traffic must have stagnated; and our trade, instead of having been shaken only, would have been wholly subverted and annihilated. Let us then be thankful that our liberties are preserved to us entire; that although we have indeed felt the shock which has palsied so great a portion of Europe, and reduced many of its states to trembling imbecility, we are still suffered to live, and breathe, and enjoy our being; and let us, above all things, seriously and

stedfastly exert ourselves to avert the difficulties that surround us, with that manly and temperate zeal which becomes the British character.

Among the useful arts, it is difficult to select one that is not very immediately dependant upon chemical principles, and in reverting to the history of those arts, we shall find ourselves obliged to confess, that their leading improvements have been derived from the same source. It would be trite and tedious to enumerate all that chemistry has done for the arts of bleaching, dyeing, calico-printing, and tanning. In the arts of pottery, of glass, and porcelain making, or in the apparently more remote operations of the brewer and the distiller; but it may not be useless to inform you, that the discovery of the present mode of making oil of vitriol, of preparing vinegar from wood, of extracting the pure acid from the lemon; that the abstruse and apparently abstract inquiries into the propagation and effects of heat, are so many sources whence these improvements have been derived, and whence individuals, often ignorant of their origin, have enriched themselves, and benefited the community. I the rather dwell upon these things, because it is a common, though a gross error, to depreciate the abstract inquiries of the philosopher and the chemist; to consider all as empty and idle that does not contribute to immediate instruction or profit; forgetting how frequently it has happened, that even he who has excited the derision of his contemporaries, has merited and received the gratitude of posterity. "If what appears little be universally despised, nothing greater can be attained, for all that is great was at first little, and rose to its present bulk by gradual accessions and accumulated labours."

To enumerate all the advantages which science has conferred upon the arts, and thence to deduce its influence upon the welfare of our commercial interests, would lead me to inquiries of such extent and importance, as to exceed my adequacy to do justice to them; I can only recommend the investigation as well deserving attention, and more especially to those who sceptically deny the happy results of the intercourse between Science and Art.

Before I take my leave, I feel it my duty on this occasion, to advert to, and answer some objections that have been urged against

literary and scientific establishments, considered in their relation to the mercantile world, and as affecting particular classes of society.

It has been said, that literary and scientific attainments are incompatible with that attention to business, with that activity of mind, which is essential to those who would flourish in mercantile and commercial occupations; and it has been supposed, that the young man who is just entering upon the career of life, is particularly open to such objectionable and unpropitious influence. But let us candidly and dispassionately look at the state of this question. There is no one whose mind can always and incessantly bear direction to one subject; whose thoughts will always run in the same channel; the bow must sometimes be unstrung; diversity of occupation must be resorted to for relief; and amusement must sometimes become our business. Whatever our occupation may be, some degree of variety and relaxation is required, and it is admitted upon all hands, that if these gaps and chasms in the life of a man of business are not employed in the acquisition of some kind of information, or in the cultivation of some branch of literature, science or art, they will seldom remain harmlessly employed. There are fortunately very few whose minds are so degenerate as to rest quiet in absolute idleness; and if these do not resolve to be industrious, they will seldom be employed without injury to themselves or others; unable to contain themselves in a neutral state, they invariably sink into vice, when no longer soaring towards virtue. It is indeed so absurd to suppose, that the attention of a man of business is to be injured and distracted by occasional incursions into the regions of literature and science, that all objections to establishments like ours, founded upon such imputations, require only to be mentioned, in order to be rejected as the vapid miasmata of ignorance, or despised as the illicit offspring of prejudice and credulity. The mind of man was never intended for an "unweeded garden", but was formed for cultivation and embellishment. By the union of literature and science with the ordinary affairs of the world, we not only derive present enjoyment, but lay up a stock of future satisfaction, which tends to recreate the languors of age, and to shed a lustre upon the evening of life. How different must be the view of past life in the man who is grown old in know-

ledge and wisdom, from that of him who is grown old in ignorance and folly! The latter is like the owner of a barren country, that fills his eye with the prospect of naked hills and plains, producing nothing either profitable or ornamental; the other beholds a beautiful and spacious landscape, divided into delightful gardens, green meadows, fruitful fields; and can scarce cast his eye on a single spot of his possessions that is not covered with some beautiful plant or flower."

The last, and I trust to the present audience, not the least interesting subject, that it is my business at present to advert to, relates to the opportunities offered by establishments of the nature of this Institution, in improving female education. "It is not," said Sir H. Davy, in propounding the plan of the Royal Institution, "it is not our intention to invite them to assist in our laboratories, but to partake of that healthy and refined amusement which results from a perception of the variety, order, and harmony, existing in all the kingdoms of nature; and to encourage the study of those more elegant departments of science, which at once tend to exalt the understanding and purify the heart."

It is somewhere said in the Rambler, that all appearance of science is particularly hateful to women; and that he who desires to be well received by them, must qualify himself by a total rejection of all that is rational and important; must consider learning as perpetually interdicted, and devote all his attention to trifles, and all his eloquence to compliment.

It is barely possible that such might have been the state of things at the middle of the last century; but the case is now widely different; and, in consequence of the diffusion of general knowledge and information that appears in all respectable classes of society, ignorance every where meets with contempt. In these observations it is very far from my intention to recommend the abstract sciences as part of female education, but merely to advise the acquisition of general information. Pedantry is at all times nauseous, but never so disagreeable as in female attire, where it is always indicative of the absence of the more estimable and useful mental acquirements.

Let us then indulge the hope, and exert ourselves for its ful-

filment, that within these walls Science and Literature may establish a permanent and friendly intercourse with Commerce and Trade; that they may enter into a league against ignorance, pedantry, and prejudice, in defence of the true ends of knowledge; that their merits may be duly appreciated, and set forth with dignity and with truth; and that these means may be so directed to the improvement of the moral as well as the intellectual character, that "our Merchants may become as Princes, and our Traffickers the truly honourable of the earth."

ART. II. *Microscopical Observations on the Red Snow. By* Francis Bauer, *F. L. S. F. H. S., in a Letter to* W. T. Brande, Esq, *Sec. R. S., &c.*

Dear Sir,

ALTHOUGH I had heard various reports and opinions respecting that curious phenomenon, the Red Snow (discovered during the late Northern Expedition, under the command of Captain Ross, on the 17th of August, 1818, in Baffin's Bay, in lat. 75° 54', N. and long. 67° 15'. W.) I had no opportunity of seeing it, until the 28th of February last, when I received a quart bottle full of the melted snow, for the purpose of ascertaining (as far as it could be effected by microscopical observation,) whether the red colouring matter were an animal or a vegetable substance.

I now venture to lay before you a detailed account of the mode and result of my investigation; and if you should deem it deserving the honour of insertion in the Quarterly Journal of the Royal Institution, it is entirely at your service.

After the bottle had remained at rest for eighteen hours, I found on examination that its contents consisted of perfectly clear water, having deposited a sediment at the bottom of the bottle, not quite a quarter of an inch in thickness (or in proportion to the water, as 1 to 34.) apparently consisting of an extremely fine powder, of a dark red colour.

Carefully uncorking the bottle, without disturbing its contents, I dipped a small ivory instrument into the clear water, and placed

a drop, which covered a space of about a sixteenth part of a square inch, upon a plain glass; and bringing it under the microscope, I observed it to be pure water, on the surface of which were floating about 15 or 20 extremely minute organised spherical corpuscles, or globules, of different sizes, perfectly colourless and transparent. I repeated these operations several times, and found always the same appearances.

I then shook the bottle, in order to mix the sediment with the water, which was very soon effected, and the whole contents became tinged with a light crimson colour. Putting a small drop of this coloured water upon the plain glass, and bringing it within the field of the microscope, I observed some hundreds of similar globules, of various sizes, most of them nearly opaque, and of a fine dark red colour, all of which soon sunk to the bottom, but the transparent and colourless globules remained floating on the surface of the water.

These globules I could compare to nothing but either the pollen of some plants, or to the minute fungi of the genus *uredo*.

With this impression on my mind, I examined the subject more closely, and, employing stronger magnifying powers, soon found several individuals still adhering to their pedicles, the same as I have found in most species of *uredo*, and which distinguishes these minute fungi from the pollen of some plants.

As the water on the glass under the microscope gradually evaporated, I observed also the same granulated glutinous substance which always issues from those fungi when ripe, and which I believe contains its seed. When the water is entirely evaporated, and the globules become quite dry, they stick together in the same manner as all species of *uredo* do, and in that state they can hardly be distinguished in shape or colour from the *uredo fœtida*.

Having dried a sufficient quantity of these globules, I put them upon some hot iron, and the smell of the fumes proved also that they are vegetable matter.

The above experiments I repeated, with a sufficient quantity of the *uredo fœtida*, and the results were precisely the same; the ripe and coloured fungi sink to the bottom of the glass, or bottle, and

form the same kind of sediment, and the unripe and colourless fungi remain floating; and when put, in a dry state, upon hot iron, the smell of the fumes is the same as that which is produced by the red globules.

It was at this stage of my investigation, and after I had ascertained the above facts, that I gave it as my opinion, that the substance which gives the red colour to the snow is not of animal origin, but a fungus of the genus *uredo*. This was on the first of March last, several weeks previous to the publication of Captain Ross's narrative of the voyage, and before I knew that any one else had investigated the subject, which I only learned when I read the accounts given in the publication; but at that time I had already pursued the subject further, and ascertained additional facts, all of which tended to confirm my first opinion; at the time when I expressed that opinion, I had only seen the fungi in a detached and loose state (see Figs. 1, 2, 3, and 4, in the annexed Plate,) but on the 14th of March, as I was pouring out a larger quantity of the contents of the bottle, I observed several flakes, of a jelly-like white substance, with many of the full-grown red fungi adhering to it, which, when brought under the microscope, proved to be the same cellular or articulate root, or spawn, which is common to most species of *uredo*, (see Figs. 5, 6, 7, 8, and 10.)

On the 16th of March I poured a considerable quantity of the coloured water into a large conical-shaped rummer, to obtain more of the sediments; when, after it had been standing at rest twenty-four hours, I found, on examination, that, although a considerable quantity of sediment had been formed, the inner surface of the glass, as far as the water reached, was entirely covered with a single layer of the red fungi. This appearance continued unaltered till the fourth day, when I observed the fungi were gradually losing their colour, and small flakes of the jelly-like spawn became evident in several spots on the inner surface of the glass; and after the glass had stood at rest three days longer, I found the fungi had entirely lost their colour, and the new-formed spawn had increased considerably; and on bringing a small portion of the substance within the field of the microscope, I found the white

spawn the same in appearance as that which I found in the original bottle, and a great many very minute colourless young fungi were adhering to its surface.

After the glass had stood at rest another week, I examined another portion, and found the new spawn had not only considerably increased in quantity, but even the mark made on the glass where I scraped the first portion off, was nearly obliterated, being overgrown by newly-formed spawn, and the new fungi had nearly attained the ordinary size of full-grown fungi, but were still perfectly colourless, (see Fig. 6.)

I have since repeatedly examined the contents of the glass, but have not observed any material change. The increase of new fungi continued evident for about three weeks; since that time the marks on the glass from which the substance had occasionally been removed, remained visible and uncovered, and the fungi, accumulating in large clusters, detached themselves from the glass, and sunk to the bottom, without ever attaining the red colour, though the substance has now been exposed to the open air for the last ten days and nights. Hence it appears evident, that the new-formed fungi never come to perfect maturity; and that, when the seed of the primitive plant is exhausted, the increase ceases.

The original red, as well as the newly-produced colourless fungi, when left to dry, become both the same brownish gray colour, (see Fig. 7;) but if the red fungi, whilst fresh, are bruised and rubbed on the skin of the hand or the face, they form a pigment of the most bright vermilion, or red lead colour, which remains unchanged, even over night, and till it is washed off with soap and water.

The results of Dr. Wollaston's chemical analysis, published in Captain Ross's narrative, correspond also in every material point with those obtained by Tessier, in experiments made with *uredo fœtida*, and *uredo segetum*. (See *Traité des Maladies des Grains*. Par M. l'Abbé Tessier, p. 225-235.)

Having diligently ascertained the above facts, I feel now not the slightest hesitation in saying, that the substance which gives the red appearance to the snow is a new species of *uredo*, and for which I think the most proper specific name is *nivalis*.

There can be no doubt but this new species of *uredo* grows upon the snow where it is found; for it appears impossible that the substance could be brought from any distance by the wind, or any other means, to that spot in so great a quantity; for it is stated in Captain Ross's narrative, that the extent of the crimson cliffs is about eight miles; the sides of the hills on which it was found are about six hundred feet high; and he says, the party which he had sent to procure some of the snow "found that the snow was penetrated even down to the rock, in many places to a depth of ten or twelve feet, by the colouring matter; and that it had the appearance of having been a long time in that state." But it is not stated in how many places the party had been digging ten or twelve feet deep in the snow.

In a journal of the same voyage, published by an officer of the Alexander; in the account given there of the red snow, it is stated, p. 63. "This substance, whatever it may be, is very plentiful, on this part of the coast, the snow being covered with it in different places to a considerable extent. It is soluble in water, to which it gives a deep red colour, but, when allowed to settle a little, sinks to the bottom, leaving the water almost colourless. It is worthy of remark, that this colouring matter, be it what it may, *does not penetrate more than an inch or two* beneath the surface of the snow," *&c. &c.* This appears certainly more probable; however, it will be better to leave this little difference to be settled by the respective travellers.

Mr. Brown, in a very short note, published in Captain Ross's narrative, expresses an opinion that the plant might be a *tremella*; and quotes *tremella cruenta,* in the English Botany, Fig. 1800. That plant I have not yet seen in nature, but, judging from the quoted figure, as well as from the description, I am firmly persuaded it is no tremella, but most likely an uredo. The authors of the English Botany, in their description of this plant, say, "When examined with a microscope, it proves to be a congeries of extremely minute, pellucid, globular granulations, all equal in size."

They conclude their description with saying, "We are well aware that it can only rank as a *tremella* till more observations are made on the subject."

It is true all the species of *uredo* which I have hitherto examined, and those described by Persoon, are parasitical plants, growing upon other vegetables; but that I think does not prove that there are none that grow otherwise. I know at least one instance that these same parasitical plants can, and do, vegetate and propagate on other substances than living plants, for, in 1807, during my investigation of the diseases in corn, I put some barley and oat ears, which were partially infected with smut (which is the *uredo segetum*,) into brown paper, to preserve as specimens, in which, on examining them in about three or four months afterwards, I found the fungi had not only entirely consumed several of the ears, but had continued growing and multiplying on the paper, on which they had spread from the several spikets of the ears in distinct rays, of two or three inches in length, and the quantity of fungi thus produced on the paper is at least three times the quantity the original ears could have contained; these specimens are still in my possession. I have no doubt but that the *uredo segetum*, as well as the *uredo fœtida*, vegetate and propagate in like manner on the soil, it being a known fact that the purest seed-corn, sown on land which, several years before, produced those diseases, will likewise be infected, though, during the interval, no wheat or barley has been cultivated on that ground; and it is not probable that these fungi and their seed should have been lying in the ground inactive for several years; but their extreme minuteness, and their dark colour, renders it almost impossible to detect them on the ground; perhaps some future observations might ascertain these facts more decisively.

The method I have used to ascertain the real shape and size of these fungi, is that which a thirty year's practice and experience has convinced me to be the most simple and most accurate; and, in cases of such extremely minute objects, the only practicable mode, *viz.*, by means of a glass micrometer, in a Dollond's compound microscope.

The micrometer employed on this occasion, was a line of an inch in length, divided into 400 parts, which divides the square inch into 160,000 parts, or squares. On examination under the microscope, I found that four full-grown fungi, in a close line,

occupy exactly the space of a $\frac{1}{400}$ part of an inch in length, (see Fig. 1;) therefore 1,600 of these fungi are required to form a whole inch in length. Hence the real diameter of an individual full-grown fungus of *uredo nivalis* is the *one thousand six hundredth part of an inch.*

In the annexed plate, Fig. 1, represents a $\frac{1}{160,000}$ part of a square inch, and shews that, in order to cover its whole surface, 16 fungi are required; consequently, to cover the surface of an entire square inch, *two million five hundred and sixty thousand* such fungi are requisite.

The above $\frac{1}{160,0000}$ part of a square inch (Fig. 1.) being represented of the size of a whole square inch; it is therefore magnified 400 times in diameter, and 160,000 times superficies, and every object represented within that square is consequently magnified in the same degree, *viz.*, *four hundred times* in diameter, and *one hundred and sixty thousand times* in superficies.

The form and size of the fungi is ascertained, as above stated, by means of the glass micrometer, in a transparent state, and their colour, by placing them on white paper, and viewing them with a strong magnifying single lens, in an opaque state.

To afford an opportunity for immediate comparison, I have represented in the annexed plate, two well-known species of uredo, viz. *uredo fœtida*, which grows within the grains of wheat, and constitutes the disease known by the name of *smut-balls*, or *pepper-brand* (see Figs. 10, 11,) and the *uredo graminis*, which grows on the leaves of wheat and most grasses, and occasions the disease called the *red rust*, (Fig. 8, 9.) Those figures are magnified in the same degree as *uredo nivalis*.

FRANCIS BAUER.

Kew-Green, 25*th April*, 1819.

Explanation of the Plate. (*Plate* VI.)

Fig. 1. A $\frac{1}{160,000}$ part of a square inch, containing 16 full-grown fungi of *uredo nivalis*, magnified 400 times in diameter, or 160,000 times in superficies.

Fig. 2. Some young fungi.

Fig. 3. Some full-grown fungi, but larger than the usual, or general, size.

Fig. 4. A large sized fungus, in a colourless and transparent state, when it is seen that these fungi are neither recticular nor cellular, but the granular contents are in that state perceptible.

Fig. 5. A cluster of fungi of different sizes, on their spawn, as found in the original bottle.

Fig. 6. A cluster of nearly full-grown colourless fungi, on their spawn, as lately grown in an open glass in the house.

Fig. 7. A small cluster of full-grown fuugi, in a dry state. All the above figures represent uredo nivalis.

Fig. 8. A cluster of the same fungi on their spawn.

Fig. 9. A $\frac{1}{400}$ part of an inch in diameter, sustaining 3 full-grown fungi of *uredo graminis.* In these fungi a hexagonal recticulation is perceptible.

Fig. 10. A cluster of the same fungi of different sizes and ages, on their spawn.

Fig. 11. A $\frac{1}{400}$ part of an inch in diameter, sustaining 4 full-grown fungi of *uredo fœtida.*

Every object in this plate is magnified *four hundred* times in diameter, and *one hundred and sixty thousand* times in superficies; and if the objects were contemplated as solids, they would be magnified *sixty-four millions of times.*

Art. III. *Additional Remarks relating to the Ægina Marbles, described in the Sixth Volume of this Journal. By* C. R. Cockerell, *Esq.*

I visited Athens with Mr. Foster, in 1811, and we had the good fortune to meet with a society of Germans, whose objects and pursuits were, like our own, chiefly directed to the remains of art. In examining the temples of Athens, with our lamented friend and companion, the Baron Haller*, some details, of sin-

* This estimable and ingenious man expired at Athens, after a short illness, brought on by exposure to the malarià of the country. His virtues, and singularly amiable qualities, have rendered his loss most severe to his friends, and his death has deprived the world, in a great measure, of many valuable notices on Greek remains, which his long stay and unexampled diligence had collected. The portion of his labours in which I had a part,

gular interest and novelty, induced us to form the project of excavating the Temple of Jupiter at Ægina, for the purpose of ascertaining how far these might be found common to other remains of Grecian architecture, as well as for the general object of advancing our studies.

Mr. Linckh, of Stutgard, joined our party, and in the latter end of May, we visited the remains, and pitched our tent under the platform on which the temple stood. An ancient cave immediately under the north-east angle of it, which doubtless served the purposes of oracular and other mysteries of the god, was now converted into the habitation of our servants, and for the conveniency of our encampment.

Being at some distance from the village, we provided ourselves with arms, and a Janissary from Athens; for the Saronic gulf is so infested with the Mainiot and other pirates, as often to deter travellers from risking a visit to so remote a spot.

We, however, formed a strong party, and watching by turns with a blazing fire, for which the woody sides of the Panhellenian Mount provided very amply, we were in little apprehension of interruption. Here we passed nearly twenty days in the delightful pursuit of this excavation, and we attained completely the object of our journey, in the restoration on paper, from the admeasurements we procured, of every detail of this ancient temple.

We had not expected the extraordinary result which forms the subject of this Memoir, for it could hardly be supposed that a period of at least 2,000 years could have passed, during which from the curiosity of travellers, even the hand of man, should have left these singular remains unnoticed.

The present proprietor, His Royal Highness the Prince Royal of Bavaria, has reserved the publication of the details of his statues on an enlarged scale, and as they are now placed in the Gallery at Munich, it is hoped that they will shortly appear with all the minuteness and attention due to such interesting subjects; the casts of them, however, which, by an agreement at the sale,

is, however, in my hands, in consequence of an arrangement between us at the time of our separation; but the greater part are in the possession of H. R. H. the Prince Royal of Bavaria.

were to be furnished to the several former proprietors, are daily expected in England. The exertions of Mr. Foster and myself to acquire the originals for this country, are well known to those acquainted with the proceeding of the Committee of the House of Commons, on the subject of the Athenian Marbles.

The Æginetan statues furnish the only illustrations in our possession, of the heroic costume and armour, as described by Homer, Æschylus, and the earliest Grecian writers; and the great nicety of execution in the smallest details, corresponds perfectly with the exactness which the poets have observed in their description; a minute and scrupulous attention is paid to each tie and fastening, and as if the whole had been offered to the severest scrutiny, the parts never seen, were equally furnished with exact resemblance of each particular detail, in the most ancient coins of Corinth, Sybaris, Posidonia, and the earliest Greek cities of Italy, as well as of Ionia, which were much earlier proficients in arts, than those of Greece Proper; and in the vases of the most archaic style (commonly in black on a red ground) we trace the character which is developed and explained in these statues.

In Fig. 1 *, the right hand and wrist are restored; the whole of the wrist, though in various fragments, was perfectly preserved. The person whom it represents has received a wound in the breast, apparently by an arrow, which seems to have been of bronze; the incisure is deeply cut; the right hand is endeavouring to extract it; the attitude is singularly supported on the left arm, the hip, and right leg:—the countenance is smiling and unmoved; the hair, waving regularly from the centre of the head, is curled in two rows with great exactness, and falls down the back in a long and broad mass. On the left and right shoulder are three small holes, by which fillets or ringlets, ornamental to the head, and in metal, were fastened; the hair is, besides, bound with a fillet or string.

Fig. 2. Every part of this statue was found entire, and in its general form and anatomy, we are struck with the resemblance to nature: the stage of the art is, as already described, remarkably

* See the Plates in the last volume of this Journal.

exemplified, and to make men as they are, was evidently the object of attainment*. The body is spare and short; the limbs are strong and full; the head (see Plate, No. 2,) is rather large: of the helmet there is no other example in antiquity, nor was the exact description of this species given: two pieces, γενειαστηρια, which covered the cheek were erected on the hinge, which is very exactly formed, the rest fitting the head, has a piece prolonged, which covered the nose and forehead, as far as the eyebrow. The φαλος, or rim, which carried the λοφος, or crest, was wrought in a separate piece, and was attached to the helmet at the apex; the crest retained signs of a red colour, hung down at the back: it was usually of horse hair ἵππουρις, or feathers; the helmet also was ornamented with painting in encaustic, and on the front, over the forehead, are several holes, by which something ornamental, probably in bronze, was attached: where the helmet covers the neck were also some holes, in which curls of lead were inserted: remnants of it were found in them, and in another fragment of a head, several ringlets, very exactly formed, were still remaining: detached curls in bronze have been found before: see the *Bronze Herculaneum*, tom. i. to v. 2 and 11; but these offer the first example of such a material. Across the breast, and over the right shoulder, are signs of the τελαμων, or sword belt, and his hand was wrought hollow to receive the spear, which was of bronze or other material, and might have been the εγχος, or καμλος, the long spear:—the other combatants, from their situation in the pediment, would only have used the δορυ ορεκτον, or καμλιον προβολιον or missile short spear; and it is interesting to observe this detail of military tactic: the archer, unable to bear a shield, requires a constant companion and protector, and the long spear would be particularly applicable to such a purpose. The motion is momentary, and the angular position of the limbs is admirable, and singularly adapted to fill his place in the pediment: it has also a character of great energy, and contrasts well with the attitudes of the surrounding figures. It

* Lysippus, who flourished about 200 years after this period, and when the art had made sublime efforts, held as a precept of the ideal, to make men as they seem to be, not as they really are.—Plin. l. 54. c.

had no other support than at the feet and point of the knee, which were attached to a plinth let in at the top of the cornice. The shields are formed with extraordinary exactness in Parian marble, and seldom more than half an inch thick, though wrought in one piece, and in some instances solid with the arm and body: it is the Argive *ασπὶς ευκυκλος*; the *τελαμῶν* or handles were very nicely formed to the arm; the inside of them retained signs of red colour, and within a circle of the exterior, a blue colour was discovered in several, which, as a field, received, without doubt, the symbol adopted by the hero; on a fragment of one in the east front, we found in relief a part of a nymph.

No. 3. The head, the hands, the right leg from the knee, and part of the left, were restored. The costume is highly interesting: the body is covered with a leathern jacket (*Σπολας*) which is tied by several strings on the left side, under the arm; two straps of the same piece pass over the shoulders, and tie on the breast; the arms are uncovered; the *ζωστὴρ* or *μιτρα* of brass in straps, in two thicknesses, covered the lower part of the body, and a small tunic, in very exact plaits, came below this, and appeared also under the arms: the quiver was found, and the manner in which it was evident, by the corresponding holes, that they were sustained at the left side, is very singular: the top of the quiver was pierced for the insertion of the heads of arrows in bronze or lead. From the action in the muscles of the arms of the remaining part of the figure in general, it was evident that he had just discharged the arrow. From below, such a position is remarkably happy in effect.

No. 4. This figure is of the most beautiful sculpture; the forms are elegant, at the same time that they are full of vigour. Except the head, which has been restored, every part is entire, and large portions of the shield; from the situation in the pediment, it is evident that the spear must have been short, and in the vases are several examples from which this has been indicated. The belt, and other particulars described in No. 2, are applicable to this also, and in the whole of this figure, by the most careful observation, no other visible support was perceived than its own balance on the feet, which were attached to a plinth inserted in

the upper part of the cornice. But it is on No. 5, as the principal attraction in the picture, and on which the interest chiefly rests, that the sculptor seems to have dwelt with the greatest pleasure and attention: the body and limbs are of the utmost beauty, and with the greatest possible delicacy in the execution; there is a lassitude through every part very admirably expressed; it is at the moment of falling; the hand grasping the sword, still supports him, and the left bears the shield, though the hand has dropped from its handle: the head is of singular beauty, and though found in a separate fragment, and the neck so injured as to have spoilt the joint, it undoubtedly belonged to this figure; see Plate 2, No. 5. The helmet is thrown back, and seems falling from the head; the eyes and nose, and the cheeks of it were wrought entirely hollow, and disengaged from the head, in a manner that surprises by its boldness and delicacy; the hair is finished with the utmost nicety; and though the countenance, like the rest, is unmoved, no means has been spared to give an interest extraordinary to each part of this statue: the left leg is much bent, to admit those of the Minerva, and it was this circumstance, and the shortness of the left arm in the execution of the statue, in correspondence with the spot in which it was found, which persuaded me of its position in this part of the composition. Every part of this figure, though in pieces, was found. The whole of the weight is thrown on the left hand, which was placed on a plinth, as above.

No. 6. In this magnificent statue of Minerva, who, by her action, seems from Olympus to have just alighted to animate the combat by her presence, we have the most antique costume hitherto known to us. The form of the Ægis is singular, nor have we seen it before in sculpture, surrounded with the tassels, the noise of which was said to have dismayed her opponents: we know such a sort of appendage to have been in much earlier use, than the more usual one of the serpents. These were undoubtedly of brass, or some metal which has disappeared: they were fastened by rivets of lead, most of which still remained: the holes by which the Gorgon's head was attached to her breast were evident, and the whole of the Ægis was painted with scales in

encaustic, the colour could not however be discovered: ἁλυσιδωτὸς, λεπιδωτὸς, φολιδωτὸς were the terms used for such ornament. It is very large, and formed a cloak and breast-plate, admitting the arms to wield the shield and spear. The former had an additional τελαμὼν or collar from the elbow to the shoulder, which attached it more securely, and this had also straps which passed round the body. The head bent forward, is extremely beautiful, (see Plate II. fig. 6.) The helmet is of a singular character, painted in encaustic, and enriched besides with ornaments applied, the rivets of which still remain; the φάλος is elevated from the head by a serpent; by the holes in her ears it cannot be doubted that she had ear-rings, the χιτὼν or tunic is plaited with the utmost care, and the peplos hanging from her arms, is arranged with the same regularity in the front, and at the back; it forms two large plaits, from which others diverge in regular divisions. The feet stand obliquely, the motive of which was in part the inconvenience of placing the fallen hero before her; but more, I suspect, to resemble some famous Palladium; and the same position occurs frequently in the vases. Every part of this beautiful statue is preserved entire, and the buckler solid, and of the same block of marble with the figure.

No. 7. The legs only, and portions of the thighs, sufficient to show the position of the figure, were found in this instance; but the exact resemblance of their character with the corresponding one of the East, leaves no doubt of the intention of this figure.

No. 8. The whole of this is entire, except portions of the legs and the right hand. It is to be regretted (though it is one of the most striking proofs of the devotion of the artist) that the best view of this grand and majestic figure is turned towards the tympanum. A very distinguished character is given to the head (see Plate II. fig. 8.) as one of the most important in the picture. The helmet is of that kind termed γεῖσον; the hair and beard are very nicely arranged, and at the back a cap or lining is seen underneath; the loplos descending along the back, had a small stud left in the solid of the marble, at the back of the figure, for its security and greater firmness. The shield was of the same block with the rest, and is most surprisingly supported, by the thickness of the

shoulder and arm alone. On the shield is indicated the field in which the symbol of the hero was painted, but of which no certain traces remain.

No. 9. None of these statues are more singular and novel than this; it is a complete Phrygian apparel; the ἀναξυρίδες, a tight dress of leather fitting the whole figure, to the ancles and wrists, was besides painted in scales with encaustic colours; the bonnet or mithra occurs frequently on medals and vases; but the singular form of it has never been so well understood, the back part of it descends on the shoulders, and two straps which occasionally came under the chin, were in this turned and tied behind the head. The hole in which the ringlets were inserted are seen all round; the jacket descends to the thighs, and is closed on the breast, and the pantaloons are under this, descending to the ancles. The ζωστὴρ sustains the quiver, which was found perfect. The action of the hands and manner of holding the string and arrow are explained in Plate 2, fig. 9; the manner also of drawing the bow-string to the breast, exactly as Homer describes it, is observable in all these archers. See Homer's Il. 8, v. 123.

In every view this elegant figure is one of the most graceful and pleasing in the group; except the point of the cap, every part was found entire. The position is bold, for it is momentary, and it is singularly calculated for the observer below. Except its plinth, it had no other support than its own due balance on the feet.

No. 10. The energy of this figure is admirable; though concealed by the shield, every part is finished with attention; the sword-belt is easily traced over the shoulders, but by the position of the right hand, it evidently held the spear. Except a portion of the head and the right foot, every part of this figure is preserved.

No. 11. This recumbent figure is also entire, though much corroded from exposure to the wet, having been found near the surface. The left hand is on the left knee, in which is seen a deep incision, as of an arrow; he does not seem to extract it, but seems to press it as if in suffering pain; the hair, like the corresponding figure in the left, is exactly arranged, and hangs down

the back in curls; the same holes are seen on the neck as of ringlets, and the sword-belt may also be traced over the shoulders.

The two small female statues on the apex were found entire, except the heads and the left hands holding the pomegranate flowers; their feet, on a small plinth, were still attached to the ornamental pedestal on which they stand; we recognize in them the well known costume and attitude of the Ελπὶς of the Greeks, of which the various museums and coins furnish so many examples exactly similar in every respect, and in the most archaic style. Although various passages of ancient authors and the number of statues of this goddess, sufficiently attest her importance amongst the Greeks; yet we have no mention of temples to her honour in any instance of a similar application*. It cannot but appear, however, that while they are highly ornamental they are also singularly appropriate to the subjects beneath them, for while the battle is suspended Hope might still preside†.

In Plate II. the small female head belonged to corresponding figures in the East of a dimension somewhat larger; various fragments of them as traced were found, sufficient to prove their general similarity, though not enough to restore them even on paper. The hair, curled with great care, is confined by the σφενδόνη, the ear-rings are cut in the marble. It will be observed also, that the apex, by the various fragments of it discovered, was on a much larger scale, corresponding with the proportionally greater importance, and the number of the statues and richness of composition and decorations in the East front.

We have various examples of ancient bas-reliefs, as well as passages † which represent Fortune as the companion of Hope. In the temple of Jupiter at Olympia, a victory on the apex was placed; it is possible these might have had the same signification, and it would seem that where Minerva takes a decided part,

* See Museo Vat. vol. iv. Tav. viii. and vol. vii. Tav. xx. Visconti's description of the Candelabra, &c. in Museo Etrusco, Tav. xxvi.

† Theogn. v. p. 37, Vas. di Salviani, p. 71. and Antholog. lib. 1, cap. xxv. Nos. 2 and 3.

Victory would attend her; with the same propriety, Hope should be present while the contest is undetermined.

The acroteria on the apex in the West, as before observed, was found nearly entire, Its nice construction and manner of adapting it to the roof and tiles, and the exquisite perfection of every part of it excited our wonder and admiration; it is of Parian marble also. The griffins or chimera surmounting the angle of the pediment (see Plate II.) were found at each corner of the temple, and though much broken, fragments enough were found to give complete authority for their restoration in drawing, except the head, which is taken from the Teian medals; it was a portion of one of these which Chandler discovered in his hasty excavation at this temple, and mentions as the legs of a greyhound.

The lion's head attached to the extreme tile was found perfect, and in the blocking which carries the chimera was a sinking, corresponding with the thickness of the plinth to which the legs were attached.

It is hardly necessary to repeat, that the whole of the ornaments indicated on the several members of the cornice were painted on the marble in encaustic; as are the extreme tiles, forming the upper moulding of the pediment, and on the stone of which the whole temple was constructed, is a thin coat or varnish of very fine and hard plaster.

Art. IV. *On the Periodical Suspension and Renewal of Function, observable in the Human Body.* *By* J. R. Park, M.D.F.L.S. & M.R.I.

ON THE CAUSE OF SLEEP.

The most remarkable instance of periodical intermission of function is that attendant upon sleep; and it may excite surprise in the minds of those who are not aware of the imperfect state of our knowledge of the animal economy, to find this familiar affection classed amongst those phenomena which the physiologist is unable to explain or account for.

That the nature and cause of sleep have never been truly as-

certained, appears from the discordance of opinion that still prevails amongst the most eminent writers respecting the physical state of the brain which produces it.

How much our ignorance on this subject is to be lamented, may be readily appreciated by reflecting, that a disturbance, or morbid change of this affection, forms a prominent feature in many formidable diseases; and the physician cannot be supposed to possess an adequate knowledge of their nature, whilst he remains unable to account for one of their leading symptoms.

But the importance of the subject may be placed in a more striking point of view.

The operations termed mental immediately proceed from the brain, which is as much the organ of mind, as the eye is the organ of sight; and the state of the mental powers as much depends upon the condition of the organ of mind, as the sense of vision depends upon that of the organ of sight.

Now sleep, which is a temporary suspension of the mental faculties, is almost universally ascribed by physiologists to a peculiar state of the brain; but if the nature of that state, or of those changes which produce a periodical remission and renewal of activity in the brain be unexplained, it is evident that the laws are not yet ascertained, by which its function is governed. And it is not to be conceived, that the real nature and cause of morbid derangements, or aberrations of the mind can be known, whilst the knowledge of its healthy function is wanting.

The physical cause of sleep is a question then, which involves some of the most interesting problems in medical science; and its solution is, in fact, indispensable as a preliminary step to the consideration of others more immediately practical which will follow.

To expose the errors and inconsistencies of others is an ungracious, and far from a pleasing task; but where it is essential to the establishment of truth, as in the present instance, it cannot be dispensed with.

Sleep is described by most physiological writers, as a suspension of function exclusively confined to the organs of voluntary motion and mind. But the same authors, when inquiring into the phy-

sical change which occasions it, nearly all concur in ascribing it to a peculiar state of circulation in the brain.

Now circulation belongs neither to the class of mental nor voluntary functions, but is decidedly involuntary or automatic. If sleep then proceed from change of circulation, it originates in the vascular system; and the vessels being involuntary organs, it is surely inconsistent and erroneous to regard the remission of action which occasions it, as peculiar to mental and voluntary functions.

That sleep really does arise from change of circulation in the brain, as these authors admit, it is the object of the present essay to demonstrate; but at the same time to point out more precisely than has hitherto been done, the nature of that change; and moreover, to ascertain its cause, which these writers have not investigated.

The cause of this change of circulation will be found similar to that which produces periodical fluctuations of activity in other moving organs; or the subjection of the vascular system to the general laws of fibrous contraction. And the influence, which this change exerts over the mental faculties, will be seen to accord in every respect with the influence of altered circulation on other functions.

But before we proceed to the illustration of this doctrine, it will be proper to state more particularly the opinions of former writers respecting the physical cause of sleep.

This statement, as it regards some of them, must unavoidably bring into view a circumstance little calculated to inspire confidence in the accuracy of their reasonings; which is, that sleep is ascribed by different authors to diametrically opposite states of circulation; namely, by some, to too much, and by others to too little blood in the cerebral vessels.

It is singular, that these authors in ascribing sleep to altered circulation, should not have been prompted to investigate the cause of the periodical change of vascular action thus implied and admitted. Such an inquiry might have led to the detection of that important principle in pathological science,—the subjection of the vascular system to the general laws of muscular action.

And it might further have been expected, that, the connexion which in this instance was perceived, and tacitly allowed to prevail between the activity of the mental powers, and the state of circulation in the brain, would have directed the attention of physiologists to a more strict examination of the same connexion in other organs and other functions.

This examination would have led to the detection of the other equally important principle,—that, the state of every function immediately depends upon the actual condition of its capillary vessels.

Upon these two points, the foundation of pathological science may be said in a great measure to rest; and sleep, as well as every other suspension or remission of function, results from the operation of these laws.

To return to the opinions of former writers, the following are the views offered by the most eminent authors.

Sleep is ascribed by Cullen to collapse of the brain, by which is to be understood, as he explains (in his *Institutions of Medicine*, Part I. p. 95), a state of diminished mobility in the nervous fluid.

Darwin and Brown referred sleep to the diminution of excitability or sensorial power in the brain, which according to their views is expended during the day, and re-accumulated during sleep.

Haller, after shewing the probability of cerebral congestion, comes to the following conclusion: "Sleep, therefore, arises either from a simple absence, deficiency and immobility of the spirits; or from compression of the nerves; and always from the motion of the spirits through the brain being impeded. (See *First Lines of Physiol. Transl.* p. 285.)

Richerand disputes the doctrine of pressure from blood accumulated in the brain causing sleep; and, on the contrary, after enumerating the circumstances that denote a diminished circulation, he concludes, "that the brain falls into a state of collapse during its continuance; a proof that the quantity of blood carried to it is considerably diminished." (*Elements of Physiol.* p. 294. translation, London, 1807, 2d edit.)

Blumenbach takes a similar view, and considers that sleep arises from want of circulation, or diminished afflux of arterial blood to the brain. (See *Institutions of Physiology*, p. 178. transl. by Elliotson, 2d edit.)

Bichât referred sleep to an ultimate law of nature, establishing, as he conceived, the necessity for alternations of action and rest in the animal functions, whilst he maintained along with others, that the organic are exempt from this law. (See *Recherches Physiologiques*, p. 34.)

Whytt does not offer any explanation of the cause of sleep; but in his valuable treatise on the Vital and Involuntary Motions, he shews that the heart and other involuntary organs experience a diminution of sensibility during sleep, in consequence of which their action is retarded. (See *Vit. & Inv. Mot.* section 12.)

The most obvious objection to the doctrines of Cullen, Darwin, Brown, and others, which assume either a change in the quality, or deficiency in the quantity of the nervous power, is the suddenness with which this state is often removed; as when sleep and mental weariness are instantaneously dispelled by an impression on the mind. An objection that will not apply to the doctrine about to be submitted.

The inconsistency of representing sleep as an affection exclusively confined to voluntary functions, and yet referring it to altered circulation, seems to have been perceived by Bichât alone; who accordingly evades this dilemma by waving the inquiry into its cause, and referring it to an ultimate law of nature.

The facts that suggested this explanation, were too striking to be overlooked; and it is singular that they did not point out the evident subjection of involuntary as well as voluntary organs, to periodical change of action.

Whether sleep be ascribed to too much or too little blood in the brain; still, in either case, a periodical change of circulation is admitted.

If diminished circulation be deemed the cause of sleep, then the blood must be sent less forcibly to the head, to produce the change in question; and to account for this, the heart, which is

also an involuntary organ, must be allowed to be subject to periodical diminution of action.

If increased fulness of the cerebral vessels be supposed the cause of sleep, then a diminished resistance or periodical relaxation in these vessels must be admitted to take place, in order to account for their fulness; for it will hardly be contended, that the action of the heart is augmented, or the impulse of the blood stronger during sleep than waking.

Thus, in either case, the origin of sleep is referred to the class of involuntary organs; and a periodical remission of their action must be admitted to occasion it.

In fact, if the doctrine about to be submitted be correct, it will be seen that there is some foundation for both these opinions; and it would appear, that the partial manner in which the subject has been viewed is the chief cause of the contrariety of opinion that prevails.

Sleep will be found to result from full and slow circulation in the brain; proceeding from a spontaneous relaxation of the cerebral vessels, occurring simultaneously with a retarded pulse, from diminished action of the heart.

The periodical recurrence of this state, results from the general laws of fibrous contraction, to which the heart and capillary vessels are subject no less than other moving organs. And the influence which this change of circulation in the brain exerts over the faculties of the mind, is similar to the influence of altered circulation in every other function.

In order to substantiate the truth of this doctrine, however, the same method of proof is called for, that was pursued in regard to the doctrine of hunger. In the first place, the cause alleged must be independently proved to have a real existence; and not be hypothetically assumed to explain the phenomena. Secondly, the phenomena must be shewn to accord completely with the cause alleged. And, lastly, any objections to which this explanation appears liable, must be fairly met and answered.

The cause assigned for the diurnal revolutions of sleep and waking, being the same as that to which the periodical returns of hunger and thirst were ascribed; namely, the alternate remis-

sion and renewal of activity in the circulating system, its reality has, it is hoped, been already shewn. But, since the periodical change of vascular action, is a fact not obvious at all times, owing to numerous circumstances that may disturb its regularity, it is of some moment to notice the statements of those who have been esteemed the most accurate observers of nature.

The names of Haller, Hunter, Whytt, and Bichât, will ever command respect; and each of these writers has noticed the diurnal fluctuations of the pulse. They concur in stating that it is generally somewhat languid and feeble in the morning; becomes fuller and stronger about mid-day; grows rapid and irritable towards evening, the usual period of febrile exacerbation; and at length becomes full and slow at night as sleep approaches.

Here then, we have the successive stages of activity in the vascular system distinctly marked, and these stages of action succeeded by a state of comparative relaxation or rest.

The circumstances, however, that may disturb or modify these changes are numerous, for the vascular system is subject to the influence both of corporeal and mental impressions. Diversity of occupation and pursuits; difference in habits of life, as to activity or indolence, temperance or indulgence ; in short, any thing that operates powerfully on either mind or body, may so affect the pulse as to render it difficult to verify the uniformity with which these stages occur.

Moreover, in the state of perfect health the changes are too slight almost to attract attention, and have therefore generally escaped notice, except during indisposition, when the mobility of the vessels being augmented, their range of action is increased, and their fluctuations become more perceptible. In the state of fever, for instance, these changes become very conspicuous, and the utmost importance attaches to the observance of the period at which the febrile exacerbation recurs.

The reality of the cause being then apparent, its adequacy to produce the effects ascribed to it, now calls for consideration.

The influence which altered circulation in the brain exerts over the faculties of the mind, presents in fact nothing peculiar but is in every respect analogous to the effects of altered circula-

tion in all other functions. As the power of motion and the faculty of sensation have been shewn to fluctuate with every change of circulation in their respective organs; so likewise the susceptibility for mental impressions, and the activity of the mind in the performance of intellectual operations, both vary with every change of circulation that the brain undergoes.

Thus, when circulation is impeded, as in the cold fit of an ague, the powers of perception are blunted, and the energies of the mind are impaired.

On the other hand, when circulation is much increased, as in the hot fit of fever, the reverse of this occurs; the susceptibility of impression is now rendered painfully acute, the temper becomes irritable, and delirium is apt to ensue from an uncontrollable rapidity in the succession of ideas.

Moreover, to complete the analogy, the influence which external agents possess in altering the circulation of the sentient organ, and which bodily exertion manifests in augmenting the circulation of the organs of locomotion, appears not less conspicuous in the effects of mental impressions on the circulation of the brain, and in the changes produced in this organ by the continued efforts employed in intellectual exertion.

Thus, for instance, as external irritation brings blood to the part, and causes redness of the surface; so the mental impressions of shame or anger, as formerly explained, determine blood to the brain, as indicated by the flushing of the face and redness of the eyes.

Again, as bodily exertion is attended with increase of circulation in the organs of locomotion; so long continued exertion of the intellectual powers causes a sense of weight and fulness in the head, which denotes congestion of blood in the organ of mind; and pain, after a certain period is equally apt to result from both.

If attentively considered, it will also be found, that exertion of the intellectual powers, exhibits successive stages, similar to those attendant upon bodily exertion, presenting the same fluctuations of activity, and connected with corresponding changes of circulation.

These variations of activity in the mental powers are most per-

ceptible when the mind is long and vigorously exerted; but violent exertion is far from that which is most favourable in disposing to sleep, for reasons that will presently appear.

The successive stages of activity in the intellectual function, are marked as in other organs by symptoms of gradually increasing mobility.

In the first stage, the powers of mind are not fully developed, but with exercise the brain soon attains to the possession of its greatest vigour and activity. After these have been for a certain period energetically employed, the mobility of this organ, like that of others, is liable to become inordinate, and confusion of ideas is the result: and, eventually, the power of efficiently exerting the intellectual faculties, is partially impeded or wholly suspended; and pain in the head, as already stated, is the consequence of continuing this effort too long.

In short, this periodical change of function exhibits similar symptoms in the brain and in other organs; and appears connected with the same changes of circulation, as formerly pointed out. The effects of these changes only are variously manifested in different parts; in the organs of sensation, by change of sensibility; in those of motion, by change of mobility; and in the organ of mind, by change of the mental faculty.

Although the successive stages of mental activity are most distinctly marked, when the mind is long and vigorously exerted, yet the state of circulation thus produced, is by no means that which is most favourable to the production of sleep.

This condition of the mental faculty was stated to proceed from a spontaneous relaxation of the cerebral vessels, occurring simultaneously with a retarded pulse from a similar remission of action in the heart.

Now in promoting this general relaxation in the capillary system, the increase of circulation attendant upon immoderate exertion of mind is no way favourable. On the contrary, as restlessness and pain in the limbs result from excessive bodily exertion, so over-exertion of the mind produces wakefulness and pain in the head.

The changes that result from violent exertion, may be regarded

indeed as bordering upon a morbid state from the pain liable to attend them; whereas that degree of exertion which is moderate and healthy, unaccompanied by inordinate determination to the head, and occasioning no uneasy sensation, alone disposes to sleep, for the following reasons:

In all moving organs, the state of action, as was formerly shewn, is succeeded sooner or later by a state of comparative relaxation or rest.

In the voluntary organs, the uneasy sensations which arise from over-exertion prompt us to discontinue our efforts in time; but in the involuntary organs, over which the influence of the will does not prevail, this remission of action is spontaneous.

And accordingly, like other involuntary organs, the capillary vessels at stated periods shew their disposition to spontaneous relaxation; as seen in the swelling of the lower extremities towards evening, in the flush of the face, and the redness of the eyes that accompany drowsiness; a change of action in the vessels, analogous to that which occurs in the muscular fibres of the stomach after repletion, or which was shewn to occasion the spontaneous suspension of hunger upon fasting longer than usual.

Now the exertion which disposes the capillary vessels to take on this state of relaxation must be moderate in degree; for over-distension produces the same effect in them as in other organs, or it occasions resistance and not yielding; as seen in the stomach for instance, which yields to pleasing impressions on taking food, but is roused to resistance by those which are displeasing, or by excessive repletion, and then eructations, nausea, or vomiting is the consequence.

In like manner impelling the blood too forcibly into the capillary vessels rouses them to resistance, and keeps up active circulation; as appears by the increase of vascular action in local inflammation: whilst the unfavourableness of accelerated circulation in disposing to sleep appears from the wakefulness attendant upon inflammation of the brain; and from the absence of sleep, which often continues for whole weeks during the active stage of insanity.

While increasing the stimulus of distention seems to prevent

the spontaneous relaxation in the capillary vessels; the partial abstraction of that stimulus appears to promote it; and hence the simultaneous remission of action in the heart, which causes a retardation of the pulse at night, contributes to that effect; and accordingly sleep appears to proceed from the conjunction of these causes, producing full but slow circulation in the brain.

The proof of this, however, can only be rendered complete by a general survey of the symptoms attending this state, the causes that promote it, and the means that prevent or remove it.

To return, then, the symptoms present must first be shewn to indicate the existence of this state of passive congestion, which they clearly do.

The relaxation of the capillary system during sleep, as already stated, is a general and not a local change; but as the faculties of the mind, and the powers of voluntary motion, are most conspicuously affected, it is in the organs subservient to these functions, which are the brain and spinal chord, that evidence of this change is particularly called for.

Among the circumstances that denote this state of the brain, one of the most obvious and familiar is a symptom usually preceding sleep; to wit, a certain degree of flush in the face. Now this being unattended with any increase in the impulse of the blood, can only be referred to relaxation of the vessels; and the contiguity of the vessels of the face to those of the brain affords a presumptive argument, that a similar change takes place in both.

But a more decisive indication of this state of the cerebral capillaries presents itself in the appearance of the eyes, which acquire a manifest degree of redness as sleep approaches, and are sometimes so completely transfused with blood that their vessels appear as if injected. Since the eyes derive their principal supply of blood directly from the brain, the changes of circulation in the one, may be fairly inferred from those of the other, according to the laws of vascular sympathy, as formerly pointed out.

While the cerebral vessels thus appear to take on a state of relaxation, it is reasonable to expect that those of the spine should participate in the change. For the spinal marrow, though physiologically distinct from the brain in regard to function, is yet

when anatomically considered, a part of the same organ, or a prolongation of the brain.

As the situation of this organ precludes the possibility of any visible demonstration of the changes it undergoes, we must look to its function for evidence of their existence, and here they appear sufficiently evident.

It is an admitted fact in pathology, that undue pressure in the spine, is capable of paralyzing the voluntary muscles; and morbid increase of circulation in this part, causing excessive mobility, was shewn in treating of vascular sympathies to be the most probable cause of the convulsive affections termed chorea and tetanus.

If then the vessels of the spine pass through the same periodical changes of circulation as those of the brain, corresponding fluctuations of function should be observable in the organs dependant upon the spine, or those of voluntary motion.

Now the only voluntary muscles, which are constantly and uniformly exerted throughout the day, and which are therefore diurnal in their stages of action, are those which support the head, the lower jaw, the eyelids, those of the trunk, and the muscles of respiration. These although termed voluntary, partake of the nature of involuntary organs, and continuing in action many hours together, they belong to that class in which tone and permanency of contraction predominate rather than mobility. It is therefore to be expected that this character will prevail through their different stages of action.

That stage of action which immediately precedes relaxation, or the third stage of activity, is marked by a tendency to inordinate mobility, or spasmodic action; and accordingly at this period such a tendency is evinced by the affection of those muscles that constitutes yawning and stretching, which clearly appertain to the nature of the tonic spasm, and are the frequent precursors of drowsiness.

This tonic spasm being semi-voluntary, may either be considered as an instinctive effort to obtain relief from an uneasy sensation in the organs, or as the spontaneous result of the spasmodic tendency that denotes the approach of fatigue.

Similar also in its nature is the full inspiration which often accompanies a yawn, being somewhat different from a sigh, and less like an effort to obtain relief from accumulation of blood in the lungs, than like a spasmodic expansion of the chest, from the muscles of respiration partaking of the same spastic tendency that affects those of the jaw in yawning.

The next change of function that takes place in these organs, most unequivocally betokens the presence of the stage of fatigue, and the tendency to spontaneous relaxation. The eyelids now close, the head can no longer be held up, but keeps falling forward, and the muscles of the back are so weary, that we are unable to sit erect without pain. In short, a temporary paralysis prevails, an effect which congestion in the spine is well known to be capable of producing; and that this is its cause, in the present instance, will be rendered further apparent by the consideration of the means that promote this state.

Amongst the causes that promote sleep one of the most conspicuous is the recumbent posture, which favours its accession in two ways. In the first place, it withdraws from the heart the principal stimulus that excites it to action, namely, the distending force of the column of blood descending from the head, estimated by Hales, in his Statical Essays, at four or five pounds; the removal of which, promotes retarded circulation, by allowing the heart to relax. And secondly, the horizontal posture promotes sleep, by producing permanent and moderate congestion in the brain and spine, upon the common principles of gravitation, when these parts are placed on a level with the rest of the body; and thus the conjunction of causes favourable to sleep is effected.

A moderate degree of exercise during the day is well known to render sleep sounder at night; and according to the principle that the subsequent relaxation of vessels bears a relation to the degree of their previous exertion, it is easily explained how this becomes a predisposing cause to sleep.

Sleep is promoted by most causes that excite a pleasing sensation; which have a tendency to produce relaxation of vessels, upon principles explained in treating of corporeal impressions; provided always that these causes be applied when the vessels are

predisposed to this state of quiescence. Thus after exercise, especially in the open air, and in frosty weather, sleep is promoted by a warm fire, a hearty meal, and a few glasses of wine. When the vessels have not been disposed to rest by previous exertion, exhilaration is the usual effect that results from these causes, instead of sleep.

The darkness and silence of night are evidently conducive to the production of sleep, and apparently owe their influence to the abstraction of stimulus, or the removal of all external impressions, which are calculated to keep up active circulation.

Opium and some other drugs have a powerful effect in promoting sleep; and their operation well accords with the views here offered.

Whether their primary effect be to accelerate or retard circulation, has been a subject of controversy; but its decision is immaterial to the present question, since it is allowed that their ultimate effect is to retard the pulse; and it is then, and not till then, that sleep is produced by them.

The reason why extreme cold is productive of lethargic torpor, may be accounted for without inquiring into its physical influence and mode of operation. Like opium it retards the pulse in a remarkable manner, and this alone is sufficient to account for its influence in promoting sleep.

It is, however, probable, that cold and opium act upon somewhat different principles; opium disposing the vessels to relax by deadening their sensibility; whereas cold, though it also deadens sensibility, appears further to obstruct circulation by constricting the vessels and impairing their power of action.

Whilst the constriction of vessels on the face and surface impedes circulation and retards the pulse; the blood driven inwards promotes at the same time internal congestion in the head; and thus the conjunction of the causes favourable to sleep is effected by extreme cold.

Physical causes act mostly upon distant parts, and extend their influence to the brain through vascular sympathy; but mental impressions act directly upon the brain itself, and their operation becomes therefore a question of greater interest.

Now the impressions most likely to produce drowsiness, when the cerebral vessels are disposed to rest, are such as engross the attention without exciting any lively interest; for by thus preventing the mind from occupying itself with subjects really enlivening, they actually produce the abstraction of stimulus.

Such is, accordingly, the effect of reading an uninteresting book, or listening to a long dull story. In this state of mental weariness, the obligation to make the effort increases its irksomeness; and, as a wearied traveller, at the prospect of a long and dreary road still before him, becomes more sensible of fatigue, and, feeling his strength unequal to the effort, sinks under the bare apprehension; so the mind, when weary, often sinks at the anticipation of a long and painful effort of attention.

Yet the failure of mental activity, like the fatigue of the limbs, does not proceed from actual exhaustion of nervous energy, or from a change in its properties, for let an adequate cause be presented, and the attention is presently awake again; spontaneous relaxation subsides; circulation is renewed, and the activity of the mind restored. Thus the analogy is complete between the phenomena of mind and those of loco-motion. Nor is this surprising, since they proceed, as before stated, from different parts of the same organ, the spinal marrow being strictly a prolongation of the brain.

Among the mental impressions that dispose to sleep, grief may be enumerated as one which causes, at least, a heaviness or torpor of the mind. As it was shewn that this emotion has a direct tendency to produce relaxation of vessels and congestion of blood in the head with impeded circulation, nothing farther is required to prove its coincidence with the foregoing principles.

It yet remains to be shewn, that the means which retard or prevent sleep are calculated to remove this congestion in the brain, or to prevent spontaneous relaxation of its vessels by keeping up active circulation.

How sleep is prevented by actual pain, which was shewn to excite the vessels to contraction, needs no explanation. But many internal causes of irritation are not attended with sensible pain, yet equally disturb sleep, by keeping the vessels in a state

of active resistance, and preventing their spontaneous relaxation from taking place. Such, accordingly, is often the effect of disease in internal organs, as the lungs or the liver, which is frequently unattended with painful sensation.

Certain substances, termed narcotics, as coffee or green tea, when taken into the stomach, create wakefulness. That they also quicken circulation is well known, and this sufficiently accounts for their preventing sleep.

The operation of mental impressions, which retard or prevent sleep, must be evident from what has already been offered.

As grief disposes to sleep, and creates a heaviness by causing circulation to languish, and by promoting congestion in the head; so joy which has an opposite tendency, and was shewn to operate by increasing vascular mobility, occasions wakefulness.

Fear, which is the apprehension of pain, acts in the same way as pain itself, or excites direct contraction in the cerebral vessels as formerly shewn, and has, consequently, the most decided influence in preventing sleep, affording a striking illustration of the principle in question.

In short, the symptoms present, the means that promote, and those which prevent, sleep, all concur to prove, that it proceeds from full and slow circulation in the brain, produced by the spontaneous remission of action in the cerebral vessels, simultaneously occurring with a retarded pulse from diminished action of the heart.

The objections that may be urged against this doctrine yet remain to be considered; and these will most probably be drawn from the morbid state.

Thus, it may be said, if slow circulation be essential to sleep, it should never occur in continued fever, when the pulse is always quick.

In reply to this objection, it must be observed, that the terms quick and slow are used relatively and not absolutely. A pulse that is quick to one person may be slow to another; thus, children have naturally a quicker circulation than adults, and often sleep with a pulse above an hundred. So a person in fever may obtain broken and interrupted sleep with a pulse much quicker

than is natural in health; a remission of action, with a certain degree of congestion in the cerebral vessels being all that appears requisite to suspend the activity of the mental function.

In the weakened state of vessels accompanying fever, congestion is readily produced; but whilst active circulation continues, delirium and not sleep is the consequence. When active circulation abates, and simple congestion remains with retarded circulation, lethargic torpor then supervenes; and, accordingly, contitinued fever most frequently terminates in this way.

If the recumbent position be favourable to sleep, by promoting moderate congestion in the head, why, it may be asked, do some persons sleep better sitting up than lying down.

This effect may proceed from two causes, namely, weakness in the impelling power of the heart, or in the resisting power of the vessels; which will operate, however, in different ways. Failure of activity in the impelling power, by disposing the heart prematurely to relax, will retard the pulse, and promote sleep in the sitting posture; whereas, weakness in the resisting power, by rendering the congestion inordinate, when the head is laid low, may rouse the cerebral vessels to resistance, and, for a time, prevent sleep in the recumbent posture.

The constitutional causes most conducive to this effect, are the plethoric habit, and great corpulency, circumstances which confirm this explanation. In persons of this description, circulation, at all times laborious, is particularly obstructed in the sitting posture by the tightness of the clothes, and the unequal pressure of the seat, and the heart thereby sooner wearied; whereas, the sudden removal of these obstructions, by taking off the clothes and lying down, throws the blood more abundantly towards the head, and promotes inordinate congestion, and thereby for a time, renews active circulation, and prevents sleep.

It is not improbable, in the present imperfect state of pathological science, that difficulties will occur in considering the morbid states of sleep, which the doctrine laid down may at first appear inadequate to solve. But it is to be observed, that objections are not valid which derive their force merely from our ignorance of those morbid affections; since, it is not impossible

that, were their nature thoroughly understood, they would be found to confirm rather than refute the reasonings advanced.

Some of the phenomena of sleep are supposed to fall within the province of the metaphysician rather than that of the physiologist. Of this number is

DREAMING.

The attempts, however, that have been made to explain its nature, without due regard being had to the physical state of the organ that occasions it, are not very satisfactory.

Mr. Dugald Stewart, in his explanation of dreaming, assigns as its cause, what is only one of its leading symptoms, and that by no means an invariable one, namely, the suspended influence of the will over the association of ideas, and the organs of voluntary motion.

The influence of volition, far from being invariably suspended during dreams, is often actively exerted, not only in the voluntary association of ideas, forming connected trains of reasoning, but even in the employment of our organs of speech and voluntary motion; as in somnambulism, which is certainly a species of dreaming.

Habit, which Mr. Stewart says, may produce connected associations that appear like reasoning, does not afford an adequate explanation of these effects; for habit can only produce the repetition of trains of thought that have actually passed through the mind while awake. But in dreams new reasonings often arise out of circumstances that had never occurred before, as in the following instance:

A gentleman, who had recently returned to Ireland from visiting some friends in England, dreamt that he was again in the midst of the friends he had left. But the circumstances of his return arising in his mind, he was puzzled to reconcile these recollections with the scene before him; and endeavoured to prove to himself, that he had actually returned by recalling various particulars of his departure and voyage home; until he convinced himself of the truth. On the other hand, he was still contradicted by the evidence of the scene around him; and

remembering that false perceptions or delusions of this sort attend insanity, he inferred, that he must have become deranged, until the alarm awoke him.

Now the delusion which occasioned this reasoning could never have occurred before while he was awake, and therefore the reasonings founded upon it could not be a repetition, or the effect of habit.

But farther, somnambulists, who are certainly dreaming, are very commonly found to answer rationally when spoken to, and often hold conversation for a considerable time; which cannot be referred to chance or repetition, nor explained without admitting the partial exercise of reason and voluntary association.

Instead of being wholly suspended, the will, like every other faculty of the mind, seems to be only partially impeded during dreams; and the reason of this is to be sought for in the physical condition of the mental organ.

This peculiar state of the mind consists in an imperfect exercise of the cerebral function, owing to the obstructed or oppressed state of circulation in the brain already pointed out.

Dreaming occurs at the commencement of sleep, when the mental function is partially impeded, and still more frequently at its termination, when that function is not yet perfectly restored; but is attended in each case with somewhat different circumstances.

As drowsiness approaches, and the effort of attention becomes fatiguing, the eyelids are suffered to close, and the observance of surrounding objects now no longer serving to admonish the judgment, the train of ideas is left to the guidance of chance or imagination, and soon creates fortuitous or incongruous associations, which constitute our dreams.

In this state persons forget where they are, or fancy they are still holding conversation; whilst the organs of speech are not actually employed, more because the mind is inconscious that they have ceased to be exerted, than from an inability to exert them.

The dreams that occur just before waking are somewhat different from those that take place on falling asleep; they are generally more connected and more vivid, for the following reasons:

The activity of the brain is now renewed by rest, and the current of our thoughts flows more freely; but still the suggestions of fancy are not corrected by the observance of surrounding objects, while the avenues to the external senses yet remain closed; and thus the train of ideas may still be incongruous.

Our morning dreams are more connected at one time than at another, which seems to depend upon the more or less perfect renewal of circulation in the organ, when some accidental cause of disturbance sets the mind at work again.

Another circumstance that may render our dreams more connected, as suggested in Dr. Wilson's Treatise on Febrile Diseases, is the employment of language to embody our thoughts; for though words be not actually uttered, yet the lips are often faintly seen to move, and the effort may be feebly made, and occupy nearly the same time as if they were; thus serving to restrain the rapid succession of ideas, and render them more connected. Without some check of this kind, in the renewed activity of the mind which now prevails, a whole history of fire, thieves, or murder, may be dreamt during the creaking of a hinge, or the opening of a door.

If the suspended influence of volition be inadequate to explain the phenomena of dreaming in general, without taking into account the physical state of the organ; still less is it capable of explaining the production of that most distressing species of dream, termed the night-mare or

INCUBUS.

This affection is so evidently connected with a peculiar state of circulation, that it seems to admit of explanation in no other way.

That the character of our dreams is much affected by external impressions, and internal feelings, is a well-known fact: thus in a windy night we may dream of being at sea, a hail-storm may suggest a dream of being in battle, or flashes of lightning make us dream that the house is on fire. In like manner, uneasy internal feelings are apt to produce unpleasant or frightful dreams, such as occur in the night-mare.

A sense of oppression is felt on the chest, which frequently suggests the idea of being held down, and the alarm thus excited sufficiently accounts for the frightful images presented to the mind, which are common to the affection in question.

The cause of the oppression on the chest is the point that remains to be ascertained; and the principles before explained lead to the inference, that undue congestion of blood in the spine, impeding the action of the intercostal muscles, and preventing the free expansion of the chest, is the most probable cause of the sense of tightness and oppression that is felt there.

The circumstances that most frequently produce the night-mare, such as indigestion, a heavy supper, and lying on the back, from their aptitude to occasion congestion in the spine, strongly confirm this conclusion: while, on the other hand, fear, which was shewn to excite the vessels to contraction, instantaneously dispels this affection, by removing the congestion, with the first struggle that is made; and thus farther corroborates the reasoning.

Another species of dreaming is that called

SOMNAMBULISM.

In this state, the mind is still in a dream, intent upon some imaginary purpose, and the external senses are imperfectly restored; but the faculty of speech and the power of locomotion are freely exerted.

In such a state, persons will not only answer questions rationally, but are frequently known to unlock drawers, open doors, walk out into the air, or sit down to write letters, being inconscious all the while where they are, or that they have got out of bed, and are without their clothes. If suddenly awakened out of this state, surprise or great alarm is the consequence of the immediate renewal of perfect consciousness.

The physical cause of this singular affection appears to be an irregular distribution of blood in the sensorium, or some local congestion that impedes the uniform and simultaneous restoration of the corporeal and mental faculties.

From the principles already established, it may be inferred that the spine is not in this affection, as in incubus, the chief seat of

congestion, but some part of the brain itself; for the mental faculties are evidently more obstructed than the powers of locomotion.

Moreover the moral causes that are often known to occasion this affection, such as mental uneasiness, or some secret sorrow preying upon the mind, confirm this inference, from their liability to produce this state of circulation.

Grief was formerly shewn to promote congestion of blood in the brain; and its continued operation is therefore well calculated to impede the uniform and equable renewal of circulation in different parts of the sensorium.

It is true that grief is not the sole cause, and moreover that a tendency to this local congestion, when it has first arisen from accidental causes, may in time become habitual, like that which occasions epilepsy; but where frequent repetition has not rendered it constitutional, mental uneasiness is known to be its most usual cause, and strongly confirms this view of its nature.

Thus sleep, with all its attendant phenomena, seems to depend upon the periodical changes of circulation that take place in the organs of mind and voluntary motion.

These changes are not, however, confined to the organs of mind and voluntary motion, but extend to all parts. Thus every function throughout the animal economy has its periodical remission and renewal of activity; and this change in all of them is ultimately referable to the same causes, namely, their dependance upon the state of circulation, and the subjection of the circulating powers to the general laws of fibrous contraction.

Art. V. *On the British Museum, and on Collectors.*

It is time to inform the Public that they have lost many treasures of collections in literature and in art, or suffered by their removal from the spot most congenial to their existence for national purposes, either from some apparent indignity incurred by the possessor, or, what is still more to be regretted, from an ignorance of the nature of our great national repository, the British Museum. After the irreparable losses suffered of this kind by the

most enlightend men in the kingdom, who are the students or men of letters, resident in the metropolis, it becomes desirable to revise and to promulgate the constitution or laws of the Museum. Not only is the glory of the nation concerned in concentrating in its own collection the accumulated treasures of the curious, who are desirous of bequeathing them for public utility; but a higher motive exists that such rich donations should not be lost, or circumscribed in their use, as they are when in a state of dispersion, imprisoned in obscure recesses, or exiled from their natural atmosphere. The progress of human knowledge itself will be accelerated, when the student discovers, in one sacred spot, all that human industry can afford to facilitate his researches, and to offer to his meditations; and such an institution only is worthy of a great nation. It is due time to quiet the fears, or to direct the caprice of those generous collectors, who give a wrong direction to their noble passion; whatever they bequeath to the nation should be held as a hallowed deposit, to inspire them with confidence that the undisturbed existence of collections, which they have created with so much fondness, shall be reserved in perpetuity for those congenial spirits among their successors, who will carry on an unbroken line of knowledge from age to age.

Hereafter may again arise some munificent collector, a Gough, a Fitzwilliams, a Bourgeois, and a Hunter, as we have had a Bodley, and a Harley, a Sloane, and a Cracherode. Of the first four of these eminent collectors the British Museum has lost the benefit of their collections, built up, like mighty edifices, by the rare opulence and knowledge of the individuals, in such different departments in learning and art. Yet these were originally designed by the possessors to round more perfectly the circle of human acquisitions, and to have been preserved for the nation in their own repository. The motives which occasioned these rich donations to be lost to the nation in their present insulated state, were not, indeed, always honourable to their possessors, nor sometimes to ourselves. We may, perhaps, be surprised to detect men of the most enlarged spirit acting from little personal motives, even in deeds which are accompanied by the very grandeur of generosity. . . . .

GOUGH, whom we may call our English Montfaucon, for his splendid *Sepulchral Monuments of Great Britain*, and his *Camden's Britannia*, of all men best knew the national importance of the British Museum; and, of all antiquaries, none more regretted the imperfect supplies of knowledge which had hitherto entered into the national library. A perfect collection of topographical history was the costly labour of his life, and he always signified that it should never be dismembered; nor did he omit hinting, that there was but one place where the history of our country could be appropriately found, to be always at hand, the library of the nation. Among the honours which one of his fortune and taste had set his heart on, was that of becoming one of the trustees of the British Museum; this honorary title was, as he said, the blue riband of literature. But GOUGH was a man of irritable and sullen habits, and one ever liable, in any place, to find an enemy rather than a friend. The honour he desired he never could obtain; and, though he was so magnanimous as to persist in his resolution, of never separating his collection, he was mean enough to indulge his personal pique before the public service he had proposed in his happier hours. He either revoked his former bequest to the Museum, or gave it a new direction to the university of Oxford, where, although it is deposited in "the antiquaries' closet," that land of the Latins can seldom be congenial to the Gothic story of British antiquities.

Such was the petty rancour of this celebrated antiquary; but when, on a similar occasion, we find the same irritability influencing the stronger mind of SELDEN, we must forgive so inferior a one as Gough's, while we shrink into our little selves in detecting the alloy of humanity.

SELDEN had formed one of the most curious libraries in Europe, and, even at that day, it was valued at several thousands of pounds; it was the intention of this great man to have left it entire to the university of Oxford, for we had then no national library but the Bodleian. Having occasion for a manuscript which belonged to the library, they demanded of him a bond of a thousand pounds for its restitution; nor was this demand so unusual as it appears; I have seen several bonds of this nature, with the signature torn off,

which had been executed by the historian Strype, who, when he borrowed a manuscript of Sir Robert Cotton, always pledged a bond of one hundred pounds, and, when he had two together, the bond was doubled. Yet the feelings of SELDEN were of such morbid delicacy on this point, as if his honour had been questioned, that in a moment of passion he struck out that part of his will by which he had bequeathed his library to the university, declaring "they should never have it." The termination of this affair was highly honourable to Sir Matthew Hale and the other executors. At first, having hesitated to give up the treasure, they afterwards resolved on it; because, said Sir Matthew Hale, "we ought to be the executors of Mr. Selden's *will*, and not of his *passion*." It is to be wished that such bequests as Gough's, and some which I shall mention, had found executors as mindful of the honour of the deceased, and the love of the Public.

I have heard that the late Lord FITZWILLIAMS, having determined to deposit his magnificent collection of prints with some public institution, for this purpose called at the British Museum; but, neither addressing himself to a proper officer, nor intimating his design, crudely inquired, whether the British Museum ever sold its duplicates? To a common-place question could he expect any other than the simple answer he received, that they sometimes did. On which, turning away in scornful silence, he deprived the Museum of an unique collection still so much wanted there. He bequeathed it, with the addition of one hundred thousand pounds to build a gallery, to the university of Cambridge, where, if they are preserved from mouldering, is all that the nation can reasonably expect;—from daily use, and from all the artists and lovers of art, they are safely locked up. They are of no use to the nation, and scarcely ever, but by the most painful favour to the individual. The fine collection of pictures of the late Sir FRANCIS BOURGEOIS, which he received as a heir-loom from a celebrated collector, I know was designed by him for the British Museum; but, whether from a deficient energy among its officers, or merely from the caprice and weakness of Sir Francis's character, he imagined himself somewhat slighted in a sort of treaty respecting the donation, awkwardly

begun, and unhappily conducted; he too was frightened away by the notion that the trustees reserved to themselves the liberty of disposing of them hereafter, as the duplicates had scared away Lord Fitzwilliams. Long he wavered, and could not fix on any public institution for the preservation of his pictures; when a mere accident, and a very foolish one, determined the fate of this precious though small collection. Dining at Dulwich college, a place ridiculously designated as a college, and four or five persons as ludicrously, I think, termed the fellows, influenced by the hilarity of a social glass, he was invited by a very companionable man, whose good humour was never spoiled by connoisseurship or the fine arts, to leave his pictures to them. They had a lumber-room darkened by the slips of windows of the age of Elizabeth, which, with these pictures on the walls, he imagined might assume the honours of a gallery. The imbecility of the donor instantly consented; he however left an insufficient sum to build a gallery, to save the pictures from the Elizabethan lumber-room; and the result is, that all these old masters have been sent out of town into perfect retirement, to encumber, in various ways, a society of four or five unhappy and unpicturesque monks.

In the instances which I have adduced, the errors appear to originate in the folly or caprice of the noble donors; but it is evident that their intentions were patriotic, and that, had they met the fostering zeal of more active attention to assist them to develope their designs, these treasures of learning and art had at this moment been combined in our national repository; our gallery of antiques had also presented to the students the charm of picture; our small print closet, whose iron door is now so heavily unlocked, and not easily entered, had opened for them the portfolios, which alone can afford the materials for the history of engraving through all its eras; and our library had supplied to the antiquarian and historian, many a precious volume which may be now only to be found in the corner of "the closet at Oxford."

But this has not been all the evil. The eyes of our ministers have not always been opened to these national designs; their value has not been acknowledged because it has not been comprehended; and great collections have been suffered to be broken up

and to be dispersed, which a moderate price would have secured, or even a small favour conceded to the possessor. One of the most memorable examples of this fatuity and ignorance is still fresh in our recollections; the late Dr. William HUNTER having formed a rich collection of manuscripts, medals, natural history and anatomical preparations of infinite value, designed this entire labour of his life for the nation; warm with this noble purpose he addressed the prime minister to allot him a space of ground in the metropolis for the erection of "The Hunterian Museum." This application was neglected, or perhaps refused. The result is known, how Dr. Hunter indignantly ordered that his museum, after remaining open during thirty years in London, should finally be removed to the University of Glasgow. Thus were the generous views of the noble donor contracted to a provincial town, which had extended for the metropolis, and through the metropolis to Europe itself; and the nation lost a proud possession. Sir Hans Sloane in his will expressed his wish that "his collections should remain together and not be separated, in or about the city of London, where they may, by *the confluence of people, be of most use.*"

The improved knowledge of the present day has surely not come to us weakened by any diminution of public spirit;—and I believe that the patriotic feeling will be last to die away among these noble enthusiasts. The public wants, when properly understood, will often be supplied, as they have been, by this uncommemorated race. A personal feeling individualizes them with their own collections, so that to preserve them entire inspires them with a feeling of an after-existence; it consecrates their tastes; it hallows, with a sort of immortality, occupations which their death only had interrupted.

To afford these persons the security they desire, and to direct the full stream of their public affections into the right channel, remains still to be done; nor have we yet honoured these men, whose habits of life are secluded and unobtrusive, while their minds are often wayward and fanciful; too often their generous tempers have sown their seed on some rock, or on the heath, which ought to have expanded in the shelter of the garden. ANTHONY STORER, one of these most active but silent collectors, consumed his

fortune in a collection chiefly of prints and drawings, which he bequeathed to the library at Eton; but from the nature of that and similar institutions, these donations might be inscribed with a "*hic jacet.*" There they can only repose in the gilt sepulchres of library-cases, rarely to be opened. All such things, to be useful must be of immediate attainment. A contemporary, who has nearly concluded an illustrated Clarendon, consisting of many folios of historical, antiquarian, and miscellaneous curiosities *, is most anxiously concerned where to deposit the unique collection; so imperfectly known to him, or so suspected, is the safeguard of such treasures, the British Museum, that I fear this collection will be of no service to the future historian.

I am convinced that many such noble spirits are still busied in the delightful task of creating such inestimable collections in literature, in science, and in art; and that to awaken and to foster their noble impulse, becomes an object of national interest. It is to be regretted that the stores of English literature of the late Mr. BINDLEY have been lost to the British Museum; for, strange to say, it is most deficient in those home productions which constituted the greater part of that collection. In these cases the deficient zeal either on the public's side, or on the collector's, might be corrected by a purchase after the life of the possessor, on the plan of Sir Hans Sloane, the Harleys, and Townley; where a commercial bargain was not struck, but a price, very far beneath the cost, was fixed, that the individual might not be entirely a sufferer, nor the public want the benefit of collections formed by such skilful men.

Recently two brothers, members of New College, testified their filial love to their Alma Mater, by presenting the university with a collection of the finest casts from Italy of works of art, so long wanting in that classical region; and those exotic plants, brought by the hands of two modest and unambitious Oxonians to their brothers, will assuredly scatter the seeds of taste in minds which

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* It may be worth noticing, that these cost the collector, it is said, twelve thousand pounds.

have not, perhaps, been unjustly reproached, as being more curious of words than things.

Such are the men who, at long intervals of time, appear, and supply the wants of the Public from their own love and sensibility; and from these collectors, when opulent, the BRITISH MUSEUM must look forwards for many accessions. It has had its Cracherode, its Birch, its Musgrave, and many others, who have so largely and so preciously contributed to its stores. On this occasion let me borrow the simplicity and the force of the venerable style of Sir Thomas Bodley, alluding to his noble foundation of the Bodleian library: "For we cannot but presume that casting (counting) what number of noble benefactors have already concurred, in *a fervour of affection*, to that PUBLIC PLACE OF STUDY; *we shall be sure, in time to come, to find some others in some measure* OF THE LIKE DISPOSITION to the advancement of learning." With the prescient enthusiasm of genius, BODLEY foresaw those generous spirits, who, long after, and at intervals, have carried on his great views.

29th April.

ART. VI.—*A* TIGER AND LION HUNT.

[THE following narrative of a TIGER and LION HUNT, in the upper regions of Hindostan, is extracted from the familiar correspondence of the dauntless heroine of the chace, who is a British lady of high rank, recently, or not long ago, returned from India.]

Sanghee, sixty miles N. W. of Dihlee,
22nd March.

WE had elephants, guns, balls, and all other necessaries prepared, and about seven in the morning we set off. The soil was exactly like that we had gone over last night; our course lay N. W. The jungle was generally composed of *Corinda* bushes, which were stunty and thin, and looked like ragged thorn

bushes; nothing could be more desolate in appearance; it seemed as if we had got to the farthest limit of cultivation, or the haunts of man. At times, the greener bunches of jungle, the usual abodes of the beasts of prey during the day-time, and the few huts scattered here and there, which could hardly be called villages, seemed like islands in the desert waste around us. We stopped near two or three of these green tufts, which generally surrounded a lodgment of water, or little ponds, in the midst of the sand.

The way in which these ferocious animals are traced out is very curious, and, if related in England, would scarcely be credited. A number of unarmed half-naked villagers, go prying from side to side of the bush, just as a boy in England would look after a stray sheep, or peep after a bird's nest. Where the jungle was too thick for them to see through, the elephants putting their trunks down into the bush, forced their way through, tearing up every thing by the roots before them. About four miles from our tents we were all surrounding a bush, which might be some fifty yards in circumference, (*all* includes William Fraser, alone upon his great elephant, Mr. Barton and myself upon another equally large, Mr. Wilder upon another, and eight other elephants; horsemen at a distance, and footmen peeping into the bushes). Our different elephants were each endeavouring to force his way through, when a great elephant, without a *houdah* on his back, called "Muckna," a fine and much esteemed kind of elephant, (a male without large teeth), put up, from near the centre of the bush, a royal tiger. In an instant Fraser called out, "Now Lady H——, be calm, be steady, and take a good aim, here he is."—I confess, at the moment of thus suddenly coming upon our ferocious victim, my heart beat very high, and, for a second, I wished myself far enough off; but curiosity and the eagerness of the chase put fear out of my head in a minute; the tiger made a charge at the Muckna, and then ran back into the jungle. Mr. Wilder then put his elephant in, and drove him out at the opposite side. He charged over the plain away from us, and Wilder fired two balls at him, but knew not whether they took effect. The bush, in which he was found,

was one on the west bank of one of those little half dry ponds of which I have spoken. Mr. Barton and I conjecturing that, as there was no other thick cover near, he would probably soon return, took our stand in the centre of the open space; in a minute the tiger ran into the bushes on the east side; I saw him quite plain; we immediately put our elephant into the bushes, and poked about, till the horsemen, who were reconnoitring round the outside of the whole jungle, saw him slink under the bushes to the north side; hither we followed him, and from thence traced him by his growling, back to the outer part of the eastern bushes. Here he started out just before the trunk of our elephant, with a tremendous growl or grunt, and made a charge at another elephant farther out on the plain, retreating again immediately under cover. Fraser fired at him, but we supposed without effect; and he called to us for our elephant to pursue him into his cover.

With some difficulty, we made our way through to the inside of the southern bushes; and, as we were looking through the thicket, we perceived beau Tiger slinking away under them. Mr. Barton fired, and hit him a mortal blow, about the shoulder or back, for he instantly was checked, and my ball, which followed the same instant, threw him down. We two then discharged our whole artillery, which originally consisted of two double-barrelled guns, loaded with slugs, and a pair of pistols. Most of them took effect, as we could discover by his wincing, for he was not above ten yards from us at any time, and at one moment, when the elephant chose to take fright and turn his head round, away from the beast, running his haunches almost into the bush, not *five*. By this time William Fraser had come round, and discharged a few balls at the tiger, which lay looking at us, grinning and growling, his ears thrown back, but unable to stir. A pistol, fired by me, shattered his lower jaw-bone: and immediately, as danger of approaching him was now over, one of the villagers, with a matchlock, went close to him, and applying the muzzle of his piece to the nape of his neck, shot him dead, and put him out of his pain. The people then dragged him out, and we dismounted to look at him, pierced through and through; yet

one could not contemplate him without satisfaction, as we were told that he had long infested the high road, and carried off many passengers. One hears of the *roar* of a tiger and fancies it like that of a bull, but, in fact, it is more like the grunt of a hog, though twenty times louder, and certainly one of the most tremendous animal noises one can imagine.

Our tiger was thrown across an elephant, and we continued our course to the south-west; in a jungle, at the distance of about two miles, we started a wild hog, which ran as hard as it could away from us, pursued by a *Soowar*, without success. Soon after we started, in a more open part of the plain, a herd of the nilghau. This animal is, in appearance, something between a horse, a cow, and a deer; delicate in its legs and feet; like the latter, of a bluish grey colour, with a small hump on its shoulders, covered with a mane. Innumerable hares and partridges started up on every side of us. The flat dreary waste still continued, though here and there, at the distance of some miles, we met with a few ploughed lands, and boys tending herds of buffaloes.

In a circuit of about sixteen miles, we beat up many jungles, in the hope of rousing a lion, but without success. One of these jungles, in particular, was uncommonly pretty; it had water in the midst of it, in which was a large herd of buffaloes, cooling themselves. We returned home at 3 P. M.; and after a dish of tea I fell asleep, and did not wake till eleven at night.

On the 23d we again set off at 9 A. M. in quest of three lions, which we heard were in a jungle about six miles to the north-east of our tents. The ground we passed over was equally flat with that of yesterday, but it was ploughed. When we came to the edge of the jungle, not unlike the skirts of a coppice in England, and which was principally composed of stumpy peeple trees, and the willow-like shrub, I observed the other evening, Fraser desired us to halt, whilst he went on foot to obtain information. The people from the neighbourhood assembled round us in crowds, and in a few minutes all the trees in the jungle appeared to be crowned with men, placed there by Fraser for observation. After waiting nearly an hour, we were at last sent for. We found

him posted just by the side of the great canal, which was cut by the Emperor Firoze, across the country, from the Jumna, at Firozeabad, to Dehlee, for the purpose of supplying the cultivation of this part of the country with water. Fraser had received intelligence of both a lion and a tiger being in this jungle, which now chokes up this canal. He desired Barton and myself to go down upon our elephant, and watch the bed of the canal; moving slowly towards the south, while he should enter and advance in the contrary direction; the rest of the party were to beat the jungle above, where it was so very thick, that in most places, it would have been impossible for an elephant to attempt to force a passage through it.

When we had gone about a quarter of a mile down the Nulla, there being but just room at the bottom for our elephant to walk clear of the bushes, we came to a spot where it was a little wider, and where some water had collected. Here we fell in with Fraser, on his elephant, who had met with no better success than ourselves, though we had all searched every bush as closely as we could with our eyes, in passing along. He desired us to wait there a few minutes, while he mounted the bank above to look after the rest of the elephants; though none of us were very sanguine of sport here, from the jungle being so thick, and so extensive on every side. He had hardly gone away, when the people in the trees called out, that they saw the wild beast in the bushes, on our left hand; and in a few minutes, a lioness crossed the narrow neck of the canal, just before us, and clambered up the opposite bank. I immediately fired, but missed her; the men pointed that she had run along the bank to the westward. We turned round, and had the mortification of seeing her again dart across the path, and run into the water, through the Nulla, for some yards; at which moment our elephant became refractory; kept wheeling about, and was so unsteady, as to make it impossible for us to fire. However, we followed her up to the thicket, in which she had taken shelter, and put the elephant's head right into it; when we had the satisfaction to hear her growling close to us. Just as we were expecting her charge every minute, and had prepared our musquets ready to point at

her, round wheeled the elephant again, and became perfectly unmanageable.

During the scuffle between the elephant and the *Mahout*, we heard the cry, that the lioness was again running down the bank, and a gun went off. She again crossed the Nulla, and we saw the partridges start up from a thicket into which she had penetrated. Just as we got our elephant to go well in, she ran back again, and couched under a thicket, on our left hand bank, near to which she had originally been started. All this happened in the space of a short minute. Fraser then called to us to come round the bush, as the lioness being in a line between him and us, we hindered him from firing. Just as we got out of his reach, he fired; and as soon as our elephant stopped, I did the same; both shots took effect, for the poor lioness stirred not from the spot, but lay and growled, in rather a more mellow or hollow tone than that of a tiger. All our guns were loaded with slugs, and after a few discharges, poor lioness tried to sally from her covert, and rolled over and over into the bed of the canal below. Her loins were evidently all cut to pieces, and her hind parts trailed after her. This was lucky for us, as her fore parts appeared to be strong and unhurt. She reared herself upon her fore legs, and cast towards us a look that bespoke revenge, complaint, and dignity, which I thought to be quite affecting; perhaps, however, it was the old prejudice in favour of lions, that made me fancy this, as well as that there was an infinite degree of spirit and dignity in her attitude; her head, half averted from us, was turned back, as if ready to start at us, if the wounds in her loins had not disabled her. As it was now mercy to fire, and put an end to her sufferings, I took a steady aim, and shot her right through the head; she fell dead at once, and it was found, on going up to her, that the ball had completely carried away her lower jaw. Her body was dragged up the bank, and Fraser pronounced her to be not two years old.

We now learnt, that the shot which we had heard, when down below, was occasioned by the lioness having made a spring at a poor man, who stood panic-struck, unable to discharge his piece, or to run away. She had thrown him down, and got him com-

pletely under her, and his turban into her mouth. The elephants all dismayed had turned back, when Mr. Wilder, seeing the imminent danger of the moment, fired at the lioness, and grazed her side. She immediately left her hold, ran back into the jungle, and across the canal, where we first perceived her. This grand sight we lost, by being stationed in the bed below; it was said to have been very fine; but then we had, instead of it, several views of this noble animal, in full vigour; and with the sight of an hyena, which also ran across the Nulla.

We then proceeded on the road to Pannuput, on our elephants, five miles to ——— which is a pretty village. Here I got into my palankeen; Wilder returned to Dehlee; and William Fraser and Mr. Barton mounted their horses, and rode on as hard as they could. I changed bearers at Seerhana, twelve miles, and arrived at Pannuput, eleven further, at midnight. The gentlemen had arrived there about sun-set. After a little bit of dinner, I was glad to go to bed. Next day, the gentlemen told me, they had crossed again Firoze's canal, which appeared very *tigerish*; but that part of it, near Pannuput, was the finest corn-country they ever saw, and doubly delightful after the fatiguing and dreary wastes we had been in for the last six days. Pannuput plains were, in 1761, (1174 of the Hegira), the scene of one of the greatest battles ever fought, between the united musselman powers of India and the Mahrattas, in which the latter were defeated; fifty thousand Mahrattas are said to have been killed, and the battle lasted three days. No traces of the field of battle are left, the whole plain being in the highest state of cultivation. It is a beautiful scene, scattered with fine trees, and the fort (a common brick one), and town highly picturesque.

William Fraser drove me to Brusut in his buggy, on the morning of the 24th; and from the plains of Pannuput I first beheld, with an old Highland play-fellow, the snowy mountains of Thibet, instead of the much-loved summit of Ben Nevis.

Art. VII. *Account of Batavia—Its Inhabitants, Commerce, Climate, &c. By the late* Dr. Gillan, *Physician to the Embassy to China, under* Lord Macartney.

(Concluded from Page 20.)

In Java and the neighbouring islands it is said that they produce extraordinary effects by means of a powder of singular composition, and of which they make frequent use. Mr. Titsing was an eye-witness to some of these effects while he resided in Japan, where he was for some time employed in the Company's business. This powder, he says, not only relaxes and unstrings every fibre of the living frame, but also preserves the dead from all rigidity and stiffness, while at the same time, from its peculiarly antiseptic virtues, it wards off putrefaction for a long time. When one dies in Japan, a skilful person comes, and taking a small quantity of this powder, puts it into the eyes and ears of the dead body. In a few minutes the joints regain their flexibility, the whole body becomes soft and yielding, every muscle contracts with ease, and they dispose of the dead in any attitude they please. Sometimes they place them sitting erect in a chair; sometimes as if reading or writing at a table; sometimes in a stooping, and sometimes in a horizontal posture, according as fancy or the choice of friends and relations dictate. This flexibility of the dead fibre, he says, continues as long as its organization remains entire, and that is for a long time. He was desirous to have a further proof of the efficacy of this singular powder, and an opportunity occurred to satisfy himself completely on this head. One of their own sailors died aboard his ship: two days after his death, when his body was now quite rigid and signs of incipient putrefaction appeared, he sent for one of those who perform these operations on the dead, to come and exhibit his art on the body of the sailor. He came accordingly, and demanded that the body should be immediately carried ashore. This was done, and the powder, as usual, put into the eyes and ears; in a few minutes the body became soft and flexible, in every part the putrefactive process was stopped, and Mr. Titsing saw the body in a cave many days afterwards, laid

in a recumbent posture, quite pliant, and without further marks of corruption. He immediately purchased, at a considerable price, a small quantity of this extraordinary powder, but never made any use of it himself; he was even afraid to touch it, dreading that if it had such wonderful powers over the dead fibre, it might *a fortiori* have still greater effect upon the living one, and induce such a degree of relaxation as might never be recovered; and thus, perhaps, an event might follow as bad as, and more permanent than, from the Javanese fascination. He says he consulted the physicians of Japan for an explanation of these astonishing phenomena. They would not communicate to him the secret of the nature and preparation of the powder, which is reserved solely for the initiated; but told him the powder was absorbed from the eyes and ears when it first exerted its resolving effects by a particular system of absorbing vessels, which continued a certain kind of circulation for several days after death, and that these vessels carried it forward through the whole body, through every fibre of which, it communicated and diffused itself. This appeared to him a very satisfactory account of the matter, and he said he had lately sent one half of his powder, accompanied with this account, to Holland, in order that the professors of anatomy, in their different theatres, might make experiments with it. Such were the accounts Mr. Titsing gave, and he firmly believed the truth of them. He promised me a small quantity of this powder, with several other curiosities, but our sudden departure from Batavia prevented me from seeing him afterwards, or receiving them.

The very short time we stopped at Batavia, rendered it difficult to make many observations on the natural history of the place. But we laboured also under a double disadvantage in this respect, in not being able to find any person there conversant with this subject. The Dutch gentlemen, who are at the head of the Company's affairs, are more occupied with commerce and the acquisition of money, than the pursuits of science; and many of them who have risen to offices and fortunes, were originally in very inferior, and even mechanical situations in life, and never had the benefit of much education. Hence they have contributed little to the advancement of natural history, although

the country abounds with materials. At some future period it may be more cultivated. There is even an Academy of Sciences lately established at Batavia, but there appears no great spirit of science among its members, nor does it promise much for their zeal that they have allowed all the astronomical and mathematical instruments of the Rev. Mr. Moln, to be sold piece-meal after his death; and the observatory to be converted into a warehouse for the Company's goods. They have already, however, published six volumes of their transactions; but as far as I understand, there are hardly any of the memoirs written by the Batavian resident members.

It has been already remarked that the situation and climate of Batavia are peculiarly unhealthy. The dirty waters carried down by the rivers from the Blaeu-wen-berg Mountain, stagnate in the canals with which the whole town is intersected, and deposit a prodigious quantity of slime and filth, which is not cleared away as it ought to be. The great canal which unites all the smaller ones into one stream before it enters into the sea, is gradually becoming shallower from this constant deposition of dirt and mud; and I was assured it had extended the point of land where it discharges itself into the bay, to a considerable distance farther than it was when Batavia was built. The bay all around the mouth of the canal to the distance of two miles, is a dirty muddy colour, and quite distinct from the colour of the sea-water farther out. The bottom, formed from this mud and clay, makes excellent anchoring ground. The quantity of putrescent animal and vegetable substances that float down the canal into the bay, and there remain in a putrefying state, and agitated by the waves, gives a beautiful phosphoric appearance to the surface of the water at night, especially when ruffled by the sea breeze. The town is large, but seems thinly inhabited, and many houses are quite empty. The houses are built, some of brick, some of stone and lime, and some only of wood and plaster. It is remarkable, however, that neither limestone or marble of any kind have yet been found in Java. They get the whole of their lime from the coral rocks, which abound in, and in some places almost entirely compose the neighbouring islands in the Straits. They send

for boat-loads of it, and burn it in the usual manner. The bastions of the two small batteries or forts which guard the entrance of the great canal leading from the bay to the town, are entirely built of this coral rock, and it appears extremely well calculated for this purpose, as its splinters would by no means be so numerous or so dangerous as the lava stone, of which the walls of the town are partly built. The only stone I saw here was of a dark blue colour. It is of a very hard dense texture, emits a metallic sound when struck, and resembles very much the lava of Vesuvius. This stone they get chiefly from the mountains, which I was told are all volcanic. In one place, about forty miles from Batavia, there is a crater still smoking. They get their marble and granite from China. The Chinese junks carry it to Batavia, but seldom as a loading; most frequently they bring it as ballast. The ground-floors of the principal apartments of the Governor and Council of the Indies in the castle, are paved with this marble, which is cut into squares of eighteen inches, for this purpose. One of these squares, when polished and laid, costs about three shillings sterling. For the pavement of their apartments they choose marbles of various colours, especially black, blue, and white, which they intermix and lay in figures of a diamond, as in Europe. Sometimes they line the faces of the sides of their rooms with this marble, to the height of about three or four feet. And often too they use for this purpose a composition of lime and pounded shells, which the Chinese call chinam. This they lay on in the form of plaster, and paint it with various colours representing the veins of marble, and afterwards polish it so well, that unless it be very closely examined, it might readily be mistaken for real marble. The houses in general rise a few steps from the street. The steps of the stairs leading up to them are sometimes of white rough marble, but most frequently of granite. The houses of lower people, and even several of the rooms in those of the higher and richer classes, are paved with large flat tiles, which they import from Holland. As there is a canal in the midst of every street, and the banks on both sides are thickly planted with trees, their shady leaves gave a pleasing appearance to the eye, and contributed to make the streets and the houses cooler;

but as their noxious effects in other respects were certainly more than a balance for this, an order was sent from Holland for cutting them all down. This order has been put in execution in some streets, and it is said it is to be enforced in all. It would certainly be much more pleasing to the eye to leave a few trees here and there at different distances, and all the good effects would be equally well obtained.

The country round Batavia, and thence back to the mountains, which are about forty miles distant, appears like one continued plain, without any hill or rising ground to interrupt the view. It is so thickly planted with trees at the same time, both in the fields, along the canals and banks of the rivers, and around the gardens and country-houses of the inhabitants, that it has rather the appearance of a forest, than of a cultivated country. I had an opportunity of going into the country behind Batavia twice; first to Mr. Wiegerman's country-house, and afterwards to Mr. Schowman's. The road leading from the town appeared nothing for several miles but a mound of earth thrown up between two canals, and formed of the soil dug up to make their bed. From the gate of the town till we came to the Pasar Tannabank, it appeared one continuous level plain. Pasar Tannabank rises suddenly about thirty feet perpendicular above the level of the road; and after you come to the top of this small eminence, the road continues level, and almost parallel to the horizon as before. Mr. Wiegerman's country-house is about two miles beyond Pasar Tannabank, and seven from Batavia. There is nothing particular to be seen either in the house or adjoining grounds. The general character of the country prevails; thick shady trees, planted in regular rows, forming avenues that terminate in a central point, as it were before the house built on that centre; and diverging and forming radii of a circle all around, seem to have been disposed and arranged with peculiar care. The grounds around are wet and marshy, and nothing here appears inviting except the hospitality and *bons vivres* of the master. He seldom comes here, and only for a night or two. The house is fitted up rather for the reception than for the convenience of numerous guests; at least, according to the European idea. There is one large hall for dinner; a portico for shade,

drinking, smoking, and conversation and cards; and several detached bed-chambers. But in each of these there are at least three beds, and not one pair of sheets in the whole of them. In this circumstance they seem to forget that strangers newly arrived from Europe are not accustomed to, nor provided with, the flowing easy night-dress of eastern climates; and that they may possibly pass a disagreeable night from damp and noisome vapours, as well as from the warm apprehensions of imagination that often presents to them the disagreeable images of the fevers, and complicated diseases of those who may have contaminated the mattress and counterpane on which they now, in vain, seek repose.

These roads which lead from Batavia back to the Blaeu-wenberg mountains, and no farther, and which have all been made by the Dutch, are divided in the middle by a paling of bamboos. One side the road is smooth, and appears to be particularly attended to; it is destined for carriages, horses, and travellers. The other side appears one continued puddle. It is the road for the buffaloes, which they employ here for ploughing the rice grounds, and dragging the carts and waggons. The wheels of these carts are made of one entire piece of wood, the cut of the trunk of a tree, about four feet diameter, and extremely thin; so that the breadth of the circumference, rolling on the ground, does not exceed a couple of inches. From this uncommon thinness they are very brittle, and cut the road like a knife, so that the wheel sinks to the axle-tree at every step. These carts are commonly heavily laden, and no care is ever bestowed upon filling up the ruts the wheels have cut; the buffaloes sink to the belly at every step, and their march is so retarded that they scarcely advance half a mile an hour. The body of the cart or waggon is made like a chest, and must be water-tight, otherwise every thing contained in them would be spoiled. The buffaloes are very common here, but none of them are found wild in the mountains or woods. They are not so large as the buffaloes of the southern parts of Europe, nor do they appear to be so strong. They are generally of a dirty dun colour; the hair is very thin, and particularly on the belly, which is almost bare. Their nostrils appear more patulous, and their ears larger. They have no palearia. Their horns are all curved backwards

in a horizontal direction round the head, so that the tips of them almost meet each other over the neck. This singular position of the horns almost renders them useless as weapons of defence; and they seem rather to butt with them like a ram, than to toss like a bull. They are quite gentle and tame in the hands of the natives. The Malays and Javanese have brought them into perfect subjection. Even the children ride upon their backs when they drive them to feed in the marshes, or to draw the cart and plough; and sometimes half a dozen of them mount upon their back, head, and neck, by way of amusement; the animal all the while remaining perfectly quiet and gentle. But these same animals become wild and ferocious at the sight of a European, whose dress and appearance seem to offend them exceedingly. The Malays, from whose bodies we perceive a disagreeable effluvium perpetually issuing, pretend that the Europeans offend their nostrils in the same manner, and that it is this disagreeable emanation that stimulates the olfactory nerves of the buffaloes, and excites in them such a disagreeable sensation that they are provoked to the utmost anger against the exciting cause. It is certain that it is not safe for a European to approach them while they are at liberty, although they are soon tamed, and patient enough under his hands and treatment in the stall. Of this we had several examples in the lion, where the wildest and most ungovernable always became very tame and tractable, when tied to the guns for a few days.

The Javanese drive these buffaloes every morning and evening into some of the canals, or into a deep ditch, where the water covers their whole bodies, except the head, which they hold up in order to breathe. In this situation they remain for a long time, while the master or driver, with a long scoop in his hand, throws water over their heads incessantly. They seem much pleased with this bathing, and always turn to meet the water, nor once offer to stir from the place till they are commanded.

The Dutch have a particular and inveterate prejudice against eating the flesh or drinking the milk of the buffalo, both which they pretend to be productive of disease. But the Malays and Javanese eat them both without any ill consequence. The

Chinese do the same; and while we remained in the Straits of Sunda, the crews of all the ships ate the buffalo, and found their flesh very good. It made excellent soup, and the flesh when stewed or boiled till it was quite tender, appeared not at all disagreeable to many of the gentlemen. Captain Macintosh had it made into Scotch collops aboard the Hindostan; and in this state, when properly dressed and seasoned with the usual condiments, it was impossible to distinguish it from European beef dressed in the same manner. These animals appear formed by nature for ploughing the rice grounds, which are so wet and marshy, that neither horses nor oxen could work in them. Each plough is drawn by a single buffalo, the plough is light, but the coulter and plough-share strong and broad. The ploughman follows after, naked from the waist downwards, and the furrow appears to consist as much of water as of soil. They have two kinds of rice—first, the common kind, which grows only in low wet grounds, and requires water constantly for its growth and ripening. Secondly, the mountain, or dry rice, which the Javanese call paddy gunning. It is commonly sown on the sides of the mountains about the beginning of the rainy season; it requires no water other than the rain and dews, and ripens about the beginning of the dry season.

There is a warehouse for drugs at Batavia, in which are deposited all the drugs of India, till they are sent by the Company's ships to Holland. There is also a Hortus Medicus for making a collection of the plants of the country, about a mile from the town, both belonging to the Company, and under the management and direction of Mr. Schowman. The island, in all probability, would afford a great number of very rare and valuable plants; but it has hitherto not been explored, nor have any persons of botanical knowledge been employed for this purpose. Accordingly the Hortus Medicus does not contain a very large collection, nor is the present superintendent of the garden well calculated for increasing it. Mr. Schowman came to Batavia when young, and in a very low capacity; he is ignorant of letters, and unacquainted with every part of science, except the names and knowledge of the few plants and trees he has in the garden, with

the habit and appearance of which he has got mechanically acquainted. He was persuaded to marry a Malay slave, who had long been the favourite sultana of the late Governor-General; and in consideration of this sacrifice, he was appointed to the double office he now holds, in which he has acquired a good deal of land and property in the country, and a very considerable fortune in money. We visited the Hortus Medicus in company with Mr. Wiegerman, and some other gentlemen, and we thought this an excellent opportunity of ascertaining the history of the famous upas-tree. The gentlemen of the council at Batavia denied the existence of the upas, and Mr. Schowman confirmed their negation. It seems the Governor and Council had been applied to from Amsterdam, to ascertain the truth or falsehood of this history. In consequence of this application they made inquiries, the result of which they thought warranted them to conclude no such tree existed. I procured a copy of the official paper, transmitted to Holland, containing the detail of their investigations, from M. Engelhart. This paper I gave to Sir George Staunton; and to it, it is best to refer for any thing further on this head. But we were not a little surprised, some time after we came out of the garden, to understand from Mr. Schowman, that he actually knew, and had in the garden where we had been, a tree, which he called, and believed to be, the upas, although it had not all the extraordinary qualities ascribed to it by Mr. Foersch. He said this tree was of an extraordinary poisonous nature; that it exuded a resin or juice, with which, when a sword, cress, or other cutting weapon, was impregnated, or even touched over, the weapon inflicted a certainly mortal wound. That the reason why he denied the existence of such a tree was, because the slaves and servants were around us while he spoke, and that he did not choose they should ever believe such a poisonous tree existed, much less that it was then growing in his garden, lest at any time they should be tempted to make an improper use of it. That the same reason had made him conceal it from every person at Batavia, except the Governor-General, and a few of the members of the Council, dreading that if it was once generally known, the worst consequences might

result from it. He promised to shew us this upas privately, when we returned from his country-house, to which he had invited us, and where Sir George, Mr. Staunton, and I were to accompany him next evening. But of this sight we were disappointed too, as we left Batavia the day before Mr. Schowman was to return to town. He showed us, however, several plants of the nutmeg tree, that had been lately brought to Batavia from the Isle of Banda, its native soil.

These plants were in a very thriving condition, and we had the satisfaction of obtaining some specimens of it, among the other productions of the garden, which were sent home by the Sullivan. One of the nutmeg plants was grown to the size of a small tree, and was planted in the earth; the others were smaller, and in pots of Banda earth, which had been sent along with them, from a belief formerly entertained that the nutmeg would not grow in any other soil. I examined this earth, and found it to be volcanic ashes, with a very considerable proportion of iron in them. Mr. Schowman had also received some of the nuts along with the plants. The nuts were sent to him in close jars, with a liquor round them, which he afterwards told me was pure water; he had planted some of these nuts in small pots of the common earth of his garden, and found to his great satisfaction that they seemed to grow very well in the soil of Batavia; and he entertained hopes that ere long they might be sufficiently multiplied in the Dutch territory in Java. The nutmeg has, in its native state, a very hard shell around it, which is broken in order to take out what we usually call the nutmeg in Europe, but which is in fact only the nucleus or kernel of the nut. Between the nut and the kernel there is a thin membranous substance, which lines the shell and covers the kernel, to which it adheres when the shell is broken—this is the mace. I went with Mr. Schowman the following evening to his country-house: Sir George, Mr. Staunton, and Mr. Wiegerman, were to follow after, an hour or two later, or at any rate the succeeding morning, unless something should occur to prevent them. The house is situated about six leagues from Batavia; the road leading to it passes by Mr. Wiegerman's house already mentioned, and is very good for four or five miles

further: after that, the country becomes quite marshy, and there are several lakes and rice fields interspersed, which being covered with water appear only a continuance of the larger lakes. On the banks of one of these lakes, and in a pleasant situation, there is a very fine villa and garden, which, with a large tract of the adjoining country, belonged to the late Admiral Hartsink, and is now occupied by his son, who was then residing there with his family. We had relays of horses at different distances; for although the horses of Java are very spirited, and go exceedingly well, they are small, and are soon fatigued from the heat of the climate, and the depth and heaviness of the roads. We had four relays for the six leagues we drove; slaves had been sent on with them before, and they took their stations at different distances, and remained with the horses under the shade of the trees, or feeding them by the side of the hedges, till we came up.

It was our intention to have proceeded the following day to the foot of the mountains, to see Mr. Schowman's larger collection of plants, which he said he had there, and particularly the tree which produces the elastic gum; he told me they had considerable quantities of it in their warehouses at Batavia, the produce of these trees, but that it was always adulterated before it was sent to Europe; and from this circumstance may arise some of the seeming contradictions in the experiments of different chemists in Europe, and who possibly may have operated on different sorts of it.

We anxiously waited for Sir George's arrival, but as circumstances had occurred to prevent him from coming at all, I did not think it proper to proceed alone, nor to wait any longer there, and therefore returned to Batavia next afternoon.

Mr. Schowman has a large farm here, and a considerable estate, which he has let to a number of tenants, Javanese, Malays, and freed slaves, in small detached portions; these tenants came to pay their respects and their monthly rents, to their landlord, while I was there. These poor wretches are not permitted longer credit for payment of their rents, than from month to month: when they approached the hall where Mr. Schowman sat, they fell on their knees, and when they spoke to him they did it

always in the same humble posture. I observed their payments were all made in Company's paper, which they delivered also on their knees to Schowman, who received it from them with great dignity; nor did they quit that posture till he had done speaking with them.

I took a walk out alone, to see the houses, families, and occupations of these Indians. Mr. Schowman, and the gentleman who had accompanied me from Batavia, would not venture out in the heat ofthe day, but sat in the hall, drinking Madeira and small beer, and smoking their pipes. Their houses appeared tolerably clean and comfortable; the women were employed in various domestic occupations—some of them were beating rice in wooden troughs, others cleaning it, and others in pounding the cleaned rice into a fine flour; and I observed a few of them employed in weaving striped cotton cloth, and others painting handkerchiefs and shawls of white cotton cloth, with a kind of paint made of cocoa-nut oil, gambir, and a brown earth from the mountains. The instrument they used for painting was made of wood, and resembled a pair of candle-snuffers, the chamber of which contained the paint, which the point, drawn very fine and tubulated, permitted to flow through it in small lines. As the paint was disposed to become thick and viscid, and on this account, as well as to fix it better in the cloth, required to be very hot, it was placed in an earthen jar over a few coals, and in this manner always kept fluid beside them; we had observed one of Wiegerman's paysannes employed exactly in the same way at his country house. The men and the children were all in the fields, or in the garden, occupied in cultivating the ground. Mr. Schowman had a number of them employed in his grounds, where he was preparing a new plantation of coffee, and sowing the phaseolus from whence the oil is made, which they burn universally here in lamps instead of candles; the oil is expressed in a mill made for the purpose, and the refuse, resembling our oil-cakes in Europe, is employed in the same way in feeding cattle and manuring the ground. For lighting the bed rooms, they usually take a common glass tumbler of a pretty large size, they fill it half full of water, then pour this oil on the top of

it, place a floating wick on it, and having lighted it, they place it in a basin of water in a corner, and leave it burning there the whole evening, and often the whole night.

In a garden adjoining to the house, Mr. Schowman shewed me the cinnamon tree; the cassia lignea, and another large tall tree, whose bark resembled much, in its taste and other qualities, that of the cinchona. He told me that the Javanese made use of a decoction of it for curing their fevers, and that it had been but very lately pointed out to him as deserving notice. He had not yet ascertained its class, order, or genus, in the Linnæan system; but he said, the trials hitherto made of its medical virtues were very favourable. There were considerable quantities of the Piper longum and rotundum, the Convolvulus Jalappa, Styrax liquida, Betel, and Areca. I got specimens of every thing from him, all of which have been sent home; he readily promised me specimens of all the drugs in the warehouse, when he should return to town, but we had sailed before he came.

Madame Schowman seemed as willing to give information as her husband; she was now much advanced in years, but seemed still to remember she had once been the favourite of the Governor-General of Batavia, the mightiest potentate in her estimation in the whole earth, of which her idea seemed to comprehend little but the great island of Java. She had a prodigious number of jewels, and precious stones of various kinds, but she appeared to value two more than all the rest; I examined them very particularly, and could discern nothing to entitle them to uncommon preference. I had heard much at Batavia of certain kinds of gems, which they told me were produced and found in certain flowers, and which were accounted of very great value; and I was told that many of the ladies wore them in their head-dress at the ball the Governor-General gave out of compliment to his excellency the Ambassador. Madame Schowman informed me these were the gems; that the first was the produce of the flower of the mountain rice, said to be generated there by the falling rain, and on that account called by a Malay name, signifying Son of the Showers. It was of a small size, oval-shaped, of a milky opaque colour, and set in gold. There is not the least truth in the

story of its origin, although Schowman himself affirmed it authentic, and every body I spoke to at Batavia had received the account of it as genuine. It was nothing but an agate: she permitted me to try it with steel, which she said it would cut, and thought that circumstance a proof of its high value. It readily gave fire with the back of my pen-knife, and had every character of agate, so as to leave no doubt about its nature. The other kind was still more precious; it was found in the flower of the Polyanthus Tuberosa—this was of rare occurrence and generated in the bottom of the flower by the dew that fell on the flower and lodged there during the night; hence it was called by a Malay name, signifying Daughter of the Dew; it was of a smaller size, but nearly of the same shape and colour as the former; she would not permit the same trial of this as of the former, as she said it was of softer texture, and might be easily broken. This ridiculous account was equally current and credited as the former. She told me another story of the polyanthus tuberosa, which appeared more natural and probable, which I was assured by every body was certainly true. This flower, like all others at Batavia, emits hardly any smell during the day, which is generally the case in hot climates; but in the cool of the evening it exhales a very pleasing odour, and on that account is usually chosen by the ladies for adorning their hair, and strewing in their beds and bed-chambers; on this account, they call it in Malay language, Sultana of the Night. But it is also destined for another purpose; they string the flowers like pearls on a silk thread, and make garlands and chaplets of them, by means of the form and position of which, they hold silent converse with their gallants at the ball or assembly. When placed on the right or left side of the head, high or low, farther forward or backward, larger or smaller in size, they convey different messages and meanings; but this language is conventional, and always previously settled between the mistress and the gallant. They often change their conventional alphabet to prevent discovery, and they always change it *in toto* when they form new connexions. She seemed to talk of these things with the reminiscence of former times, and with the skill and knowledge of one who had often practised them. When

a Javanese belle has any secret declaration to make to a gallant on whom she may have cast her eye, she usually contrives to send him privately a chaplet of these flowers, and the fruit of the Durion, which is exceedingly large, resembling in shape a water-melon, with a very thick rough rind, and divided internally into numerous lobes, containing each a kernel resembling those of the Jack, and tasting like a mixture of boiled garlic and onions.

The phaseolus, from whence the oil is produced, grows wild in Java, and in great abundance. It appeared a most valuable plant, and I wished much to get some ripe seeds of it, in order to send them to England. Mr. Schowman told me they had been sent to Holland some years ago, and that they succeeded very well, even in the open air.

I had always been told that light attracted musquitoes and flies at night, and I had always seen the servants enter into the rooms, and shut the windows, in Italy and the southern parts of France, before they carried a candle into the bed-rooms. It seemed to me that the practice, therefore, of burning oil in the evening, and through the night, in the bed-chambers, would have the same effect here, and that it was, therefore, a bad custom. Mr. Schowman told me, that it was remarked that this oil emitted a smoke, or smell, that banished the musquitoes, and that, on that account, it had come into such general use. In the country, and in the suburbs of Batavia, they are accustomed to burn resins, aromatic woods, tobacco, and the dry leaves and twigs that fall from the trees, in order to drive away these troublesome insects; as well as to disperse the thick vapour and noxious effluvia of the stagnating waters around them. Mr. Schowman seemed to make greater difficulty in giving me specimens of the pepper than of all the other plants, and he always contrived to prevent me from pulling them myself. I remarked that he always avoided those whose grains appeared most approaching to maturity, and chose those which were quite green. I was at a loss for some time to account for this, till the gentleman who returned with me to Batavia in the evening explained it to me. It seems the Dutch are particularly jealous of their pepper, and take every precaution

to prevent any ripe seeds of it from being carried away in a state capable of vegetation. It is death for any one caught in their spice islands attempting to carry off any of the plants or seeds, with a view to disseminate them elsewhere. We were told, however, by the French captain, from whom the Nereide, (afterwards named the Clarence was bought) that about fourteen years ago, a French ship went to Ceylon, and found means to carry off several plants and seeds of many of the spices, which were carried safe to the Isle of France, where, he said, he had frequently seen them himself, and particularly the pepper, in a thriving condition. He says, however, that the pepper does not form itself into such large grains as at Ceylon and the other Dutch settlements, but in other respects it is exceedingly good. This circumstance may, perhaps, one day hurt the Dutch very materially.

Art. VIII. *An Analysis of Wootz, or Indian Steel.* By M. Faraday, *Chemical Assistant to the Royal Institution.*

The object of the following experiments being to ascertain whether any other substances were present in the wootz than iron and carbon, no attention was given to the relative proportions of these two bodies. The process was therefore much simpler than would otherwise have been required, and was conducted in the following manner :—

A piece of wootz, weighing 164.3 grains, was placed in a flask, and acted on by nitro-muriatic acid and heat. It gradually dissolved, and dark-coloured flakes separated from it, which were unalterable in the acid, though boiled with it. When all action had ceased, the solution was poured off from the sediment (*a*) which was repeatedly washed with distilled water; the solution was then examined carefully, but I could find nothing in it but iron. Whilst washing the sediment (*a*) it separated into two parts; a black powder (*b*) sank to the bottom of the water poured upon it, whilst a reddish brown substance (*c*) in flocculi remained suspended; these were parted from each other.

The black powder (*b*) was fused with potash in a silver capsule, and then dissolved in water; it deposited a brown powder (*d*), and a clear alkaline solution was obtained. This was saturated with muriatic acid, and evaporated to dryness, and then being re-dissolved with a little excess of muriatic acid, a very small quantity of white flocculi were left untouched, which were insoluble in acids, and had the characters of *silex*. The solution acted on by subcarbonate of potash gave an abundant precipitate. This was washed, and when heated with a little solution of potash, dissolved in it like *alumine*. Sulphuric acid was then added, and a solution of alum was obtained, a small quantity of silex precipitating.

The brown powder (*d*) deposited by the alkaline solution, was treated with nitric acid; a little heat being applied, nearly the whole was dissolved immediately, leaving a little of a black substance. The filtered solution gave a precipitate with muriate of soda, but when ammonia was added to it, the precipitate was re-dissolved, and a small quantity of iron was thrown down. The solution contained, therefore, *silver*, from the capsule in which the fusion had been made, and *iron* derived from the wootz. The black substance left by the nitric acid, was nearly all dissolved by nitro-muriatic acid, iron being taken into solution, and a little of the substance (*b*) remaining.

The reddish brown substance (*c*) was not affected by nitric acid, but, on adding solution of pure potash to it, a clear deep brown solution was obtained, and a blackish brown sediment (*e*) remained. When the alkali of the solution was neutralized by muriatic acid, flocculi were precipitated, and the solution became colourless. These flocculi, collected together and dried, proved to be combustible, and appeared to be merely modified tannin. The brown sediment (*e*) being then examined by muriatic acid, gave oxide of iron and a little *silex*.

I have detailed the process of analysis at length, because from the small quantities of silex and alumine obtained, doubts otherwise might have arisen respecting their sources.

The wootz, operated upon in the above experiment, was part of one of the cakes presented by the Right Hon. Sir Joseph Banks to Mr. Stodart. The piece was cut from the middle of the cake

when heated to a cherry-red colour; consequently, it was submitted to chemical analysis in the same state in which it came from the crucible of the Indian-steel maker. In some other experiments 460 grains gave .3 of a grain of silex, and .6 of a grain of alumine.

Mr. Stodart at the same time furnished me with another specimen of Indian steel, expressing a wish that it also might be subjected to analysis. This, too, was in the same state in which it was imported. The appearance of it, whilst being acted on by the acid, was very different to that of the wootz, and 625 grains gave me *no silex*, and only fifteen hundredths of a grain of alumine.

420 grains of the best English steel, furnished by Mr. Stodart, were acted on, but I could obtain no earths from it. A slight appearance of opacity in a solution was at last produced, which I ascertained to be alumine contained in the tests I had used. Many comparative experiments were afterwards made with the three specimens of steel, those from India always appeared perfectly distinct from each other in the kind and quantity of earths they gave, and the English steel invariably appeared without the earths; neither was the slightest reason offered for the supposition I at first entertained, that the earths came from the tests used in the analysis.

Being engaged in the laboratory of the Royal Institution with Mr. Stodart, in a series of experiments on the alloys of steel, I was desirous, among other researches, to make an experiment, with a view of imitating wootz. In this, however, I have not yet been very successful; I have obtained specimens of iron, giving abundance of silex and alumine on analysis, and such alloys or combinations have been obtained by others; but they never present the appearance of wootz during the action of acids upon them, even though the metal used in making the alloy be in the state of steel; and if wootz owes its excellence to any portion of the bases of the earths, silex or alumine, combined with it, those substances must, I think, be either in a more perfect, or in a different state of combination, to what they are in alloys obtained by fusing iron for three or four hours, in contact with wood and the earths. *April 24th* 1819.

Art. IX. *On Sirium, or Vestium, by* M. Faraday, *Chemical Assistant in the Royal Institution.*

In the last volume of this Journal, at page 112, I have published some experiments, tending to disprove the existence of the new metal Sirium, said to be discovered by Dr. Vest; and the conclusion drawn from them was supported by the very high authority of Dr. Wollaston. Since that time I have been honoured by receiving a piece of the ore of Sirium from Sir Humphry Davy, and on reading in the *Annals of Philosophy* a translation of Dr. Von Vest's paper, in which the metal, and the method of procuring it, are more distinctly described than had been done before in this country, I considered it a sort of justice to that chemist, to endeavour to obtain from the ore I possessed the new metal, according to his processes.

The metal has received a new name from Dr. Vest, who, instead of Sirium, has in his paper called it Vestium; Sirium and Vestium are therefore synonymous, and I shall generally use the latter.

The piece of ore I possessed weighed only 75.4 grains. It appeared perfectly clean, and being finely powdered, was digested in nitric acid. It was not previously fused with glass as directed, because it did not appear to contain any calcareous spar, and also because of its small quantity. The nitric solution was poured off after two days, a greyish white powder was left, which, when dissolved in nitro-muriatic acid, gave nickel, cobalt, iron, and arsenic.

Dr. Vest directs the neutral nitric solution to be mixed with acetate of lead. In order to render my solution more nearly neutral, subcarbonate of potash was added in quantity not quite sufficient to saturate the excess of acid, and the carbonic acid driven off by heat. In this way a greyish green powder was separated, which contained nickel in abundance, with cobalt and arsenic, and a slightly acid solution remained. To this, acetate of lead was added in excess, and the mixture left in a warm place for twenty-four hours as directed; the arseniate of lead was then

separated, and sulphuric acid added to separate the excess of lead, and then by filtration a clear solution was obtained.

The next object, was, to separate the nickel from the solution, and this Dr. Vest directs to be done, by forming it into a triple salt with sulphate of potash. The solution obtained as above was concentrated, that a portion of a salt of Vestium in fine white needles might fall down, but this did not happen. It was then diluted, decomposed by potash, the precipitate washed, and dissolved in sulphuric acid, and the excess of acid saturated by potash; then more sulphate of potash was added, and the whole was evaporated, and left to crystallize. After some time the crystals that had formed were separated from the solution, and washed with cold water, and the washings being added to the mother liquor, with more sulphate of potash, it was again evaporated and crystallized. This was repeated three or four times, until sulphate of potash separated no more nickel from the solution; and now, according to Dr. Vest, I ought to have had in the solution sulphate of vestium, moderately free from other metals.

I looked eagerly for the white flocks, which are described as forming a salt of Vestium on the crusts of triple sulphate of potash and nickel, in the above process of purification, but could not observe any. I dissolved all the crusts, and re-crystallized them two or three times over, that any salt of vestium contained in them might be separated, but did not procure the flocculi as I expected; I obtained, however, a residuary solution (being the mother liquor) similar to the one mentioned above.

These solutions, being added together, were precipitated by carbonate of potash, and boiled in excess of it; the precipitate was washed, heated red hot, digested in cold diluted muriatic acid, and the green solution which was produced poured off from the portion which remained undissolved; the solution contained nickel and cobalt. The undissolved part was boiled with muriatic acid and dissolved, forming a solution which ought to have been the muriate of vestium.

The solution I had thus obtained by Dr. Vest's process, was in very small quantity, but I hoped to be able to ascertain Vestium in it. It had a faint yellowish green colour. It was evapo-

rated to dryness, and re-dissolved several times, but no white flocks separated, as was expected from Dr. Vest's description. It agreed with the account of Vestium, in being precipitated by prussiate of potash, white, and by sulphuretted hydrogen, dark, brown, and black. It was precipitated by ammonia, and dissolved in excess of ammonia. It was precipitated by carbonate of ammonia, and dissolved in excess of the carbonate, nor was it thrown down by oxalate of ammonia. Not perceiving any thing, however, in these phenomena different to what might be expected from a weak solution of nickel and cobalt in muriatic acid, I endeavoured to separate my supposed solution of Vestium into these two metals, and by means of Mr. Phillips's method, easily succeeded. Having gathered all the tested solutions that had not had other metals put into them together, I evaporated to dryness, drove off ammoniacal salts and volatile acids, separated the other acids by potash, washed the oxide, and dissolved it in muriatic acid, and then added ammonia in such excess as to dissolve the precipitate at first formed; solution of potash being then added, a precipitate fell, which was found to be nickel; a little cobalt remained in solution, and my Vestium entirely disappeared.

Dr. Vest has not said how much Vestium is contained in the nickel ore of Schladming, though the quantity is stated to be variable, and it is barely possible I may have missed the metal from its existing in very minute proportions. In following, however, the process recommended by the discoverer, I ought to have obtained it, though I do not think that process the best that could have been devised. The whole description of the metal in Dr. Vest's paper appears to be very indefinite; there is no decided and constant difference established between it and the other metals; and in examining both the regulus and its ore, obtained from Dr. Vest, I have met with no experimental evidence of its existence as a simple and new metal.

Art. X. *On the Carbonates of Ammonia and of Soda.* *By* Richard Phillips, F.R.S.E. F.L.S. M. Geol. Soc., *&c.*

During some late researches, my attention being directed to the composition of the carbonates of ammonia, I began, and had nearly completed, an examination of them, before I observed that they had been recently analyzed by Dr. Ure *; and I consider his results to be so nearly accurate, that I should have suppressed mine, if I had not noticed some circumstances respecting the compounds in question, which have, I believe, hitherto escaped observation. I am the more anxious to state the true nature of what is usually termed subcarbonate of ammonia, because, in my remarks upon the *London Pharmacopœia,* I have given an incorrect estimate of its composition.

My present communication will not contain any observations upon those salts which result from the direct combination of carbonic acid with ammoniacal gas; the constitution of these is well known, and they are represented, on the synoptic scale, by 49 for the carbonate, and 76.5 for the bicarbonate of ammonia. The ammoniacal carbonate, which I first examined, is that obtained by the mutual decomposition of carbonate of lime, and muriate of ammonia; it is usually called sub-carbonate of ammonia, and this appellation I shall for the present adopt.

It will appear, by the synoptic scale, that, if no loss occurred during the decomposition of the carbonate of lime, and muriate of ammonia, the carbonate of ammonia obtained would consist of—

One atom of carbonic acid......	27.54	45.62
One ditto of ammonia..........	21.50	35.62
One ditto of water	11.32	18.76
	60.36	100.

In order to compare the theoretical with the actual product of the operation, the following experiments were made:

One hundred grains of compact translucent subcarbonate of

* *Annals of Philosophy*, Vol. X. p. 203.

ammonia were dissolved, with the usual precautions, in dilute sulphuric acid; 54.2 grains of carbonic acid gas were evolved.

One hundred grains of the same salt were dissolved in water, and added to a neutral solution of muriate of lime; some effervescence was excited, and the carbonate of lime precipitated after the application of heat, and dried, weighed 86 grains; according to the scale, 63 of carbonate of lime are equivalent to 21.5 of ammonia; consequently, 86 indicate 29.3.

According to these experiments, 100 parts of subcarbonate of ammonia appear to consist of

Carbonic acid	54.2	
Ammonia	29.3	leaving for
Water	16.5	
	100.	

By referring to the Synoptic Scale, it will be seen that the atomic constitution, and exact composition of this salt, are as follow:

3 atoms of carbonic acid......	82.62	55.72
2 ditto ammonia	43.	29.
2 ditto water	22.64	15.28
	148.26	100.

On the scale it will be represented by $41.31 + 21.5 + 11.32 = 74.13$, or $1\frac{1}{2}$ portion of carbonic acid, one of ammonia, and one of water.

It is well known that when this carbonate of ammonia is exposed to the air, it becomes inodorous, and ceases to act upon turmeric paper. To examine the salt thus procured, the following experiments were performed:

One hundred grains of the inodorous salt were cautiously dissolved in dilute sulphuric acid; 55.8 grains of carbonic acid gas were evolved. An equal quantity of the same salt was dissolved in water, and added to a neutral solution of muriate of lime; considerable effervescence was excited, and, by heating the mixed solutions, 62 grains of carbonate of lime were precipitated; as 63 of carbonate of lime are equivalent to 21.5 of ammonia, 62 in-

dicate 21.16. It appears, therefore, that the inodorous salt is composed of

Carbonic acid	55.80	
Ammonia	21.16	leaving for
Water	23.04	
	100.	

By the scale it will be seen, that its atomic constitution and composition are as follow:

2 atoms of carbonic acid	55.08	....	55.5
1 atom of ammonia	21.50	....	21.7
2 atoms of water	22.64	....	22.8
	99.22		100.

It is therefore bicarbonate of ammonia, combined with two atoms of water; on the Synoptic Scale it will of course be represented by 99.22. On considering these statements, it will be observed that, when carbonate of lime and muriate of ammonia decompose each other, the following arrangements take place:

One atom of water
One ditto ammonia, are dissipated during sublimation;
One ditto carbonic acid
One ditto ammonia, are dissipated by exposure to the air;
Two atoms carbonic acid
One atom ammonia.

Two atoms water remain in combination, forming inodorous bicarbonate of ammonia; and it is evident that the pungency of subcarbonate of ammonia depends upon the constant dissipation of carbonate of ammonia, which occurs until bicarbonate only is left.

On mentioning some of the facts now detailed to Mr. Philip Taylor, he informed me that, in attempting to prepare bicarbonate of soda in the mode recommended by M. Berthollet, he procured a salt evidently different from carbonate of soda, but too distinctly retaining alcaline properties to be considered a bicarbonate.

Upon examining this salt, I found that it consisted of minute prismatic crystals, the most regular of which appeared to consist of rhomboidal prisms, of about 60° and 120°, terminated by quadrangular pyramids, the planes of the pyramids replacing the solid angles of the prism.

This salt suffered no change by exposure to the air: the aqueous solution reddened turmeric paper strongly. One hundred grains, cautiously decomposed by an acid, gave out 40 grains of carbonic acid gas.

One hundred grains were dissolved in water, and added to a neutral solution of muriate of lime; with the assistance of heat, 64 grains of carbonate of lime were precipitated, equivalent to 39.72 of soda.

It appears, therefore, that 100 parts of this salt consist of nearly,

Carbonic acid....................	40.
Soda	39.72 leaving for
Water	20.28
	100.

Adopting the numbers on the Synoptic Scale, it will be seen that this salt is constituted as follows:

3 atoms of carbonic acid	82.62	40.08
2 ditto soda	78.20	37.94
4 ditto water	45.28	21.98
	206.10	100.

In the second volume of the *Mémoires d'Arcueil*, p. 474, M. Berthollet has remarked the existence of carbonates of potash, and of soda, containing more carbonic acid than the carbonate, and less than the bicarbonate: he also notices Klaproth's examination of the African carbonate of soda, detailed in p. 65, Vol. II. of his *Analytical Essays.* This substance gave out 38 per cent. of carbonic acid, and lost 31 per cent. by exposure to a red heat. It is stated to consist of,

Carbonic acid	38
Soda	37
Water	22.5
Sulphate of soda	2.5
	100.

Allowing 1.5 of the water to be combined with the sulphate of soda, 100 parts of the pure salt consist very nearly of,

Carbonic acid	39.5
Soda	38.5
Water	22
	100.

It will be observed that this analysis coincides very nearly with that which I have deduced from Dr. Wollaston's scale, and it does not differ very materially from my analysis of the artificial compound.

Alluding to this native carbonate, and stating that it consists of 39 carbonic acid, +38 soda +23 water Dr. Thomson observes, (*Chemistry*, Vol. II. p. 480,) "it is evident that the African bicarbonate had lost a portion of its acid, or had never been fully saturated with carbonic acid. If we suppose this salt to be a compound of one atom of anhydrous salt, and two atoms of water, the water would amount to 19 per cent., instead of 23. If we add the four which Klaproth places to the account of the water to the acid, it would raise it to 43, which would make Klaproth's analysis approach somewhat nearer to the truth."

It appears to me, however, that, if the transfer proposed by this able chemist were made, the error would still be very considerable; the salt would then be a compound of 43 carbonic acid, and of 38 soda, whereas bicarbonate of soda consists of 43 acid, and 30.5 soda; indeed, supposing the salt ever to have been a bicarbonate, it must have lost one-fourth of its carbonic acid; but it is evident, from Klaproth's statement, that the salt which he analyzed had not suffered any change, for he remarks that the excess of carbonic acid had probably prevented efflorescence.

Mr. Faraday having obligingly supplied me with a specimen of the African salt, I found that it was distinctly crystalline in appearance, when recently broken; but the surface was not transparent, evidently from the attrition which it had undergone. The transparent salt suffered no change by exposure to the air; when moistened, it reddened turmeric paper strongly; and I found that 100 parts of it lost nearly 36.5 of carbonic acid, during solution in sulphuric acid, and it lost 30 per cent. by exposure to a red heat. It contained nearly 7 per cent. of saline and earthy impurity, which is

almost five more than the salt analyzed by Klaproth, and which will in some degree account for the smaller quantity of carbonic acid which it yielded.

The experiments which I have now detailed are, I think, sufficient to shew that the salts in question are definite compounds of 3 atoms of acid, and 2 of base; or they may be regarded as compounds of the carbonate and bicarbonate; but, whatever may be the theoretical view of their composition, they will be accurately described by prefixing *sesqui* to *carbonate*, as has been already done by Dr. Thomson, with respect to the sesquiphosphate of barytes; it will, however, be proper to remark that Dr. Thomson has accidentally stated the sesquiphosphate* to be a compound of three atoms of base, and two of acid, instead of the reverse; and I notice this, because it might otherwise be supposed that I had employed the term in a sense different from that in which he evidently intended to use it.

Art. XI. *On the Figure of the Earth, as deduced from the Measurements of Arcs of the Meridian, and Observations on Pendulums.* *By* George Fisher, *Esq.*

The figure of the earth has always been an object of interesting and important inquiry. The conclusions, however, which have hitherto been drawn from such observations as have been made for determining it, are far from affording such a satisfactory agreement in the general result, as the accuracy of the instruments and skill of the observers would have led us to expect.

The observations which I allude to are the measurements of arcs of the meridian in different parts of the world; they have hitherto (with the exception of those made in middle latitudes) been found inconsistent with an elliptical meridian; and the ratio of the earth's axes as assigned by Newton on the simple supposition of homogeneity, has been discarded to make way for other suppositions of density, which, although perhaps specimens of analytic dexterity, have been as little capable of affording us any real satisfaction as the other.

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* *Chemistry*, Vol. II. p. 475.

In determining the ratio of the earth's axes by comparing two measured arcs of the meridian in different latitudes, it has hitherto been taken for granted in the solution of the problem, that the measured lengths of arcs of the meridian, may, without any sensible error, be taken proportional to the radii of curvature at the middle points of those arcs.

The following table, however, shews the amount of error in the amplitude of the celestial arc subtending each degree of latitude, arising from this supposition:

TABLE OF CORRECTIONS.

Latitude.		Error.	Latitude.		Error.
°	°	″	°	°	″
45	45	0.2	68	22	9.3
46	44	0.7	69	21	9.4
47	43	1.2	70	20	9.7
48	42	1.4	71	19	9.9
49	41	1.9	72	18	10.3
50	40	2.5	73	17	10.4
51	39	2.8	74	16	10.7
52	38	3.2	75	15	10.8
53	37	3.5	76	14	11.1
54	36	4.2	77	13	11.3
55	35	4.6	78	12	11.4
56	34	4.9	79	11	11.7
57	33	5.2	80	10	11.8
58	32	5.6	81	9	11.9
59	31	6.1	82	8	12.0
60	30	6.3	83	7	12.2
61	29	7.0	84	6	12.2
62	28	7.1	85	5	12.3
63	27	7.5	86	4	12.4
64	26	7.8	87	3	12.4
65	25	8.2	88	2	12.4
66	24	8.5	89	1	12.5
67	23	8.6	90	0	

This table has been computed by estimating the efficacy of that part of the centrifugal force in every degree of latitude, by which a plumb line will deviate towards the southwards, from a line drawn to the earth's centre from a point on the surface, supposing

the earth a perfect sphere; and the difference of these deflections at each extremity of the measured arc, will be the error in the celestial angle subtending that arc. Thus, for instance, there will be an error in the celestial arc subtending a measured degree from 66° to 67° of no less than 8″,5; from 50° to 53° of 8″,5; from lat. 45° to 46° of 0″,2 only, and at the equator and poles of 12″,5.

This accounts for Mr. Dalby's remark in the *Phil. Trans.* 1793, where he has given some calculations on measured degrees of the meridian, whence he infers that those degrees measured in middle latitudes, will answer nearly to an ellipsoid whose axes are in the ratio assigned by Newton of 229 : 230. And as to the deviation of some others, *viz.*, towards the poles and equator, he thinks they are caused by the errors in the observed celestial arcs.

If the earth be an ellipsoid of revolution, it may be conceived that since the effect of this part of the centrifugal force in urging a body towards the equator, has been duly estimated in the constitution of this solid, that a correction for this deflection will not obtain; since, from the nature of fluids, a plumb line must always be perpendicular to its surface, in order that the whole may be in equilibrio. This is true; but as the earth becomes elliptical by virtue of this centrifugal force, so will measured arcs of the meridian no longer be legitimate measures of the radii of curvature. And so long as these measured arcs are considered arcs of circles this correction for deflection will obtain. This is an instance of the " fallacia suppositio" of Bishop Berkeley, or shifting the hypothesis, for the meridians are supposed elliptical in the general solution of the problem, and afterwards, that the radius of curvature due to the middle point of a measured arc (considered as an arc of a circle) is a mean nearly between the true radii of curvature at each extremity of that arc.

Dr. Hutton, after giving a formula expressing the relation between the earth's axes, observes—" This expression which is simple and symmetrical, has been obtained without any omission " of terms on the supposition that they are indefinitely small, or " any possible deviation from correctness, except what may arise " from want of coincidence of the circles of curvature at the middle points of the arcs with the arcs themselves; and this source

" of error may be diminished at pleasure by diminishing the mag-
" nitudes of the arcs measured: though it must be confessed that
" such a procedure may give rise to errors in the practice which
" may more than counterbalance the small one to which we have
" just adverted."

It appears, however, that the error arising from an extension of the measured arc, is greater than that arising from want of accuracy in measuring the celestial angle subtending a smaller one, as will evidently appear from the late geodesic operations in England and France. And if

A = length of an arc of the meridian, L = lat. of the middle point of that arc, $\frac{1}{289}$ = centrifugal force at the equator (compared with gravity which = 1,)

* Then will the error in the celestial angle subtending the arc A, be $\frac{1}{289} \times \cos. 2L \times \sin. A$.

The great inaccuracy in degrees measured near the equator, or the poles, must be evident without this correction to the observed difference of latitude; and it follows that those arcs measured in middle latitudes where this correction is small, have been most correct, and agreeable to the best observations on pendulums in different latitudes. If the latitudes at each extremity of the arc be determined, and the difference of these latitudes be taken as the celestial angle subtending that arc; in latitudes between 45° and the poles, the degrees should be in excess, and between 45° and the equator in defect.

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* Let $c = \frac{1}{289}$ the cent. force at the equator, the force of gravity being unity,
A = arc of the meridian,
L = lat. of the middle point of that arc;
then $L + \frac{A}{2}$ = lat. of one extremity of the arc,
and $L - \frac{A}{2}$ = do. other.

Let D and d be the deflections at each extremity,

Then since $\sin. D = \frac{c}{2} \sin. (2L + A)$ (*Vince's Flux.* 5th edit. p. 347.)

$\sin. d = \frac{c}{2} \sin. (2L - A)$

$\therefore \sin. D - \sin. d = \frac{c}{2} \{\sin. (2L + A) - \sin. (2L - A)\}$

$\therefore$ by Trig. $\sin. D - \sin. d = c \times \cos. 2L \times \sin. A$.

but since D and d are very small arcs,

$D - d = c \times \cos. 2L \times \sin. A$,

i. e. Error $= \frac{1}{289} \times \cos. 2L \times \sin. A$.

Mr. Dalby further observes, (*Phil. Trans.*, 1793), that "if it be contended, that the operations at the equator and polar circle are as correct as those in middle latitudes, and that a kind of mean between the extreme results ought to be preferred; we shall still get an ellipsoid whose axes are nearly as 229 : 230."

Let us, however, take the case of the most northern arc which has yet been measured, that in Lapland by Maupertuis, Clairault, and others in lat. 66° 20′ N., and we shall find the non-agreement of their measurement with those made in other latitudes, does not arise from want of accuracy in their measurement, but from want of the correction to the observed celestial arc.

The arc measured by Maupertuis was from Kittis to Tornea, a distance of 55023,47 toises. The star δ Draconis was observed at both places, and the difference of the zenith distances, after applying the proper corrections, was found to be 57′ 26″,9 by a zenith sector by Graham. By α Draconis it was found to be 57′ 30″,4, the mean of these is 57′ 28″,65.

Now the measured 1° (in E. fathoms) was	61194
Corr. (8″,4) per Table	—146
*Corr. for refraction	— 17
Corr[d].	61031

Here the celestial angle subtending the measured arc was determined by the difference of the zenith distances of two fixed stars δ and α Draconis, and this celestial angle observed was 57′ 28″,65, which corrected for + 8″,2 †, gives 0° 57′ 36″,85 for the corrected angle subtending the measured arc 55023,47 toises.

Likewise the 1° measured in America by Mason and Dixon in

Lat. 39° 12′ was	60628
Corr[n]. for 2″,6 per Table.........	+45
Corr[d].	60673

* This correction was omitted by Maupertuis; applied by Laplace, *Méch. Cél.* tom. 2, p. 138.

† The error will be in excess or defect, according as the stars are to the north or south of the observer, in latitudes from the poles to 45°; but in latitudes from the equator to 45° the reverse should happen.

Now by comparing these two measured arcs, *viz.*

61031 fathoms in lat. 66° 20′

60673 fathoms in lat. 39° 12′

We get the ratio of the earth's axes as 226 : 227.

And by comparing this corrected length of Maupertuis with that of Cassina and De la Caille in lat. 45° (which requires no correction), *viz.*

57285 toises in lat. 66° 20′

57028 toises in lat. 45°

We get the ratio of the earth's axes 229 : 230.

Both the same as the ratio assigned by Newton. Likewise in Liesganig's measurement there is an excess of sixteen fathoms, (upon the supposition of the earth's axes being as 229 : 230, according to Mr. Dalby's Table, *Phil. Trans.* 1793), corresponding to 1″ of the celestial arc in lat. 48° 43.

In Boscovich's measurement in 43° N., there is a defect of thirteen fathoms corresponding to 0″,8 of the celestial arc.

Mason and Dixon's measurement in North America, in lat. 39° 12 N., is reconciled in the same way; for the length of a degree, according to their measurement, is less than the computed degree, on the supposition of the earth's axes being as 229 : 230 by fifty-four fathoms, corresponding to about 3″ of the celestial arc.

I shall now refer to Colonel Mudge's conclusion (*Phil. Trans.* 1803) which is a further confirmation (if it need any) of the necessity of this correction.

" From this measurement it appears that the length of a degree of the meridian, in lat. 52° 2′ 20″ is 60820 fathoms; this conclusion is deduced from the supposition of the whole arc subtending an angle of 2° 50′ 23″,4 in the heavens, and a distance of 1036337 feet on the surface of the earth. The length of a degree at the middle point, 51° 25′ 18″ between the southern extremity of the arc and Arbury Hill, is 60864 fathoms, which is greater than the above, and exceeds it by forty-four fathoms. But this degree, admitting the earth to be an ellipsoid with the ratio of its axes, as 229 : 230 should be about ten fathoms less. If the measurement of the terrestial arc be

sufficiently correct, and the earth of an elliptic form in those latitudes, either the arcs affording those deductions are incorrect, or some material deflection of the plumb line has taken place at one or two stations from the effect of attraction."—And he concludes with observing, " that the general tenor of the observations seems to prove that the plumb line of the zenith sector has been drawn towards the south; and that by attractive forces which increase as we proceed northwards.

The idea of this deflection proceeding from local attraction is at once unnecessary, as it is likewise incapable of accounting for it; for Colonel Mudge observes, " If there be an error in the amplitude of the whole arc, from a deflection of the plumb line at either station, it is not probable that such deflection existed at Dunnose *, as a deviation of it towards the north, from a deficiency of matter towards the Channel, would tend to diminish the inequality between the two degrees. This will be evident on consideration. I am, therefore, disposed to believe, that the plumb line was drawn towards the south from the action of matter, both at the north extremity of the arc and at Arbury Hill †, but more particularly at the first. If this were partly the case, and both Dunnose and Arbury Hill were free from such prevailing cause, the total arc must be too great if taken at 2° 50′ 23″,38, by about 8″, nearly answering to 2″ on each degree. A deviation of 8″ ‡ from the true vertical is a large quantity, nor can the cause of it be assigned, unless it be supposed that the matter producing such deflection extends in a southern direction beyond Arbury Hill."

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* The Isle of Wight Station.

† The middle station.

‡ This agrees very nearly with the computed error, for since sine error $= \frac{1}{289} \times$ Cos. 2 L. $\times$ Sin. A. and L $= 52^\circ\ 2'\ 20''$

$$A = 2^\circ\ 50'\ 23''$$

Log. $\frac{1}{289}$	$=$	— 3.5391
Log. Cos. 2 L.	$=$	9.3860
Log. Sin. A.	$=$	8.6949
Sin. of Error 8″,6	$=$	5.6200

M. Rodriguez, speaking of the same irregularities, observed in the French measurement from Dunkirk to Barcelona, says: "On a attribué ces différences à des attractions locales; mais en ce cas, la latitude déduite des observations faites à Barcelone aurait dû paraître moindre que par celles de Mont-Jouy même; car la déviation du fil-à-plomb ne pouvait être occasionée que par une petite chaîne élevée de 120 ou 130 toises, qui est au nord de Barcelone, dans la direction nord-ouest; la déviation devait donc être vers le nord, et elle devait augmenter les distances au zénit des étoiles circumpolaires, et partant, diminuer la latitude; mais le contraire est arrivé, car la latitude à Mont-Jouy a été 41° 21′ 45″ tandis qu'elle serait 48″,23 d'après les observations de Barcelona. Il paraît donc qu'il faut chercher ailleurs la cause de l'irregularité et cette cause ne pourra probablement se découvrir sans répéter les observations."

The discrepancies which appear in the French measurements, as well as those in England, appear far to exceed the probable errors of observation. Notwithstanding it has been conceived *, that since the celestial angle subtending the *whole* arc in the English survey, from Clifton to Dunnose, can be reconciled to the ellipticity obtained by the French measurements, that the error must exist in the observations made at Arbury Hill, the *middle* station. M. Delambre, (*Ast.* tom. 3. p. 525), however, observes—" Il restera pourtant à concevoir comment le beau secteur de Ramsden, dont l'erreur était constante ou nulle aux deux extrémités, a pu avoir une erreur différente 5″ à la station intermédiaire."

The difference between the arc, as measured by Maupertuis in Lapland, in 1736, and Svanberg in 1805, has been *reconciled* nearly in the same way, by supposing Maupertuis to have committed an error of no less than 12″ in observing the latitude of Kettis, the northern extremity; although the latitude of Tornea, the southern extremity, was found to be precisely the same by Svanberg, as that determined by Maupertuis. The ellipticity deduced from Svanberg's measurement was $\frac{1}{307,4}$ and Maupertuis'

* *Rodriguez's Animadversions, Phil. Trans.* 1802. *Thomson's Phil. Annals*, No. 16, p. 286.

$\frac{1}{179}$. M. Delambre, in comparing the two operations, observes: "On voit déjà, par la comparaison de la partie géodésique, que l'erreur ne viendrait ni de la base, ni des triangles. M. de Svanberg remarque lui-même que la latitude de l'Eglise de Tornéa, extrémité de l'ancien arc, est la même qu'on a trouvée en 1736; tout le mal viendrait donc des observations faites anciennement au signal de Kittis. Mais on ne voit pas clairement comment elles donneraient une erreur de 12″ sur l'amplitude. Pour la rendre moins invraisemblable, M. Svanberg rapporte les premières observations faites au Pérou où l'on voit des erreurs plus fort; mais il est aisé de répondre que le secteur dont on s'était servi d'abord au Pérou, avait de grands vices de construction. Les académiciens, à l'aide d'un horloger que les accompagnait, en construisirent de nouveaux dont on pourrait encore se défier à certain point. Au lieu que le secteur du nord avait été fait par Graham, sur le modè le du secteur de Greenwich. Ce secteur rapporté en France, a servi à Lemonnier pour vérifier la découverte de l'aberration: enfin les académiciens avaient faites des expériences directes pour s'assurer que le transport ne le dérangeait pas, tout ce qu'on pourrait reprocher à nos académiciens, ce serait de n'avoir pas retourné leur secteur de l'est à l'ouest à chaque station, parce que ce retournement leur parût trop pénible; mais on peùt répondre encore que l'ayant retourné en France, ils ne trouvèrent pas que le ligne de collimation eût changé. J'ai lu attentivement un manuscrit oú Lemonnier avait consigné toutes les observations astronomiques, même celles dont on n'avait fait aucun usage, je n'y ai rien vu que pût éveiller le soupçon."

M. Delambre (*Base du Syst. Met.* Tom. III. p. 552,) has given a method of verification, by computing the amplitude of the celestial arc due to a measured one on the earth's surface, and by comparing these computed values with those observed between Dunkirk and Barcelona, has deduced an ellipticity of $\frac{1}{180}$, a result which not only cannot be reconciled to that deduced from precession and nutation, but is incompatible with the laws of gravity, for we cannot conceive an ellipticity greater than that in the case of homogeneity *. But the observations on pendulums, by M. Biot,

* Laplace has shewn that, if the planets were originally fluids, as is na-

Mathieu, and Arago, on the same meridian, give a very different result. For M. Mathieu, from six different observations from Formentera to Dunkirk, by the method of least errors given by Laplace, has deduced an equation for the length of the form of $z+y \sin^2 L$, and by substituting the values of z and y in the six equations of condition, there is not an error greater than $\frac{3}{100}$ of a millimètre, which is at Bourdeaux; at the other places, not half that quantity. These observations give an ellipticity of $\frac{1}{298,2}$ while that obtained from the length of the arc of the meridian is $\frac{1}{180}$.

There is a similar inconsistency in De la Caille's measurement at the Cape of Good Hope, for he found the length of a degree in Lat. 30° 18′ S. to be 57,037 fathoms, corresponding to a degree in 48° Latitude in the northern hemisphere; which measurement gave rise to an idea, that the two hemispheres were not similar. This idea, however, will not at all accord with observations on pendulums. M. Mathieu has given the result of seven observations made in the southern hemisphere, from Lat. 12° to 51°, which give an ellipticity of $\frac{1}{311,5}$; and nine observations in the northern hemisphere, from Lat. 7° to 60°, give an ellipticity of $\frac{1}{323,2}$. Now, if the amplitude of the celestial arc (of De la Caille's) be computed for an ellipticity of $\frac{1}{320}$ by Delambre's Formula, we shall find it 10″ greater than that observed.

Dr. Horsley, in his letter to Captain Phipps, observes, (after giving the ellipticity by the formula given by Clairaut from Capt. Phipps's observation on the acceleration of the pendulum at Spitzbergen :) "This is the just conclusion from your observations of the pendulum, taking it for granted that the meridians are ellipses, which is an hypothesis upon which all the reasonings of theory have hitherto proceeded. But, plausible as it may seem, I must say, there is much reason from experiment to call it in question. If it were true, the increment of the force which actuates the pen-

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tural to suppose, the limits of ellipticity are $\frac{5}{4}\,\alpha\,\phi$, and $\frac{1}{2}\,\alpha\,\phi$; or, if the polar axis be 1, the equatorial axis will be within the limits $1+\frac{5}{4}\,\alpha\,\phi$, and $1+\frac{1}{2}\,\alpha\,\phi$, where $\alpha\,\phi$ represent the centrifugal force at the equator, in terms of the force of gravity there; $1+\frac{5}{4}\,\alpha\,\phi$, in the case of homogeneity, and $1+\frac{1}{2}\,\alpha\,\phi$, where the whole of the matter is collected in the centre. *Méch. Céles.* Tom. II. p. 89.

dulum, as we approach the poles, should be as the square of the sine of latitude; or, which is the same thing, the decrement, as we approach the equator, should be as the square of the cosine of latitude. But whoever takes the pains to compare together such of the observations on the pendulum, in different latitudes, as seem to have been made with the greatest care, will find that the increments and decrements do by no means follow these proportions; in those which I have examined, I find a regularity in the deviation which little resembles the error of observation. The unavoidable conclusion is, that the true figure of the meridians is not elliptical." He then lays down a table of the results of six observations made in different parts of the world, and observes, "By this table it appears that the observations in the middle parts of the globe, setting aside the single one at the Cape, are as consistent as could reasonably be expected, and they represent the ellipticity of the earth at $\frac{1}{340}$. But when we come within 10 degrees of the equator, it should seem that the force of gravity suddenly becomes much less, and, within the like distance of the poles, much greater, than it could be in such a spheroid."

The credit due to these conclusions will be readily estimated, from the 15 observations made in different parts of the world from the equator to 66° N., selected by M. Laplace, *Méch. Célest.* Tom. II. p. 147; from these observations M. Mathieu has deduced, an ellipticity of $\frac{1}{318,96,}$ and who, after finding the respective difference of each observation from the general equation, observes, "Tels sont les écarts entre la théore et les mésures du pendule décimal; ils sont certainement tous renfermés dans les limites des erreurs des observations. Le plus grand écart est de 17 centièmes de millimètre, il répond au pendule du Cap de Bonne-espérance." Out of the six observations selected by Bishop Horsley, four of them are included in the above observations selected by Laplace, viz., Bouguer, at the equator, Porto Bello, and St. Domingo; and Maupertuis in Lapland; another by Green at Otaheite, agrees nearly with other observations on pendulums in giving an ellipticity of $\frac{1}{326}$. . . . .

There is as little reason to believe, "that within 10 degrees of the poles that it becomes much greater." This conclusion is

made from the single observation of Captain Phipps, in 1773, at Spitzbergen, in lat. 79° 50′ N., where the acceleration of a pendulum (vibrating seconds in London,) was found to be about 72 or 73 seconds; whereas, it was found, in the late voyage, to be 83″,36, in Lat. 79° 40′ 20″ N.

The following table shews the result of the observations on the pendulum made in the late voyage to the North Pole, taking the length of a second's pendulum in London, Lat. 51° 31′ 8″, to be 39.1386 inches, at 62° Fahrenheit, as determined by Captain Kater.

	Acceleration on mean solar time.	Latitude.	By what means.	Ellipticity.	Length.
	″	° ′ ″			
Kater.. ...	0	51 31 8N.	actual measur.	......	39.1386
Sabine....	32,86	60 10 0N.	accel. per chron.	$\frac{1}{313,8}$	39.1684
ditto....	65,23	70 26 17N.	ditto per transit.	$\frac{1}{317,9}$	39.1977
Fisher	83,36	79 40 20N.	ditto ditto.	$\frac{1}{313}$	39.2141

The equation of length deduced from the observed acceleration at Brassa Island, Shetland, in Lat. 60° 10′ N., is .... } 39.0080 + Sin.² Lat. × ,2131

Do. Hare Island, Baffin's Bay, Lat. 70° 26′ 17″ N............ } 39.0070 + Sin.² Lat. × ,2147

Do. Dane's Island, Spitzbergen, Lat. 80° 40′ 20″ .... } 39.0082 + Sin.² Lat. × ,2128

Now, the length at Unst, the most northern of the Shetland Islands, in Lat. 60° 45′ 35″ N., was found by M. Biot (according to Captain Kater's comparison of the French metre, with Sir Geo. Shuckburgh's scale,) to be 39.17193 inches. In order to compare each of the above results with this measurement, we have

The length at Unst, from the 1st equation..........	39.17025
2d..................	39.17047
3d..................	39.17023
Mean length at Unst	39.17032
As measured by M. Biot	39.17193
Diff......	.00161

If we compute the length at Unst from the equation, 39,01162 + Sin.^{2} Lat. $\times$,206638 inches, deduced by the method of least squares from the measured lengths at Formentera, Figeac, Bourdeaux, Clermont, Paris, and Dunkirk, by M. Biot, Arago, and Mathieu, on the French arc,

The length at Unst will be	39.16895
As measured by M. Biot........................	39.17193
Mean......	39.17042
Mean length at Unst, from the three equations......	29.17032
Diff......	.0001

The near agreement of these observations not only between themselves, but with others made in lower latitudes with pendulums, both with and without a maintaining power, little accords with the remark of Bishop Horsley; and, indeed, the general tenor of all observations on pendulums seems to prove (contrary to what has hitherto been concluded from the measurement of arcs of the meridian,) the meridians are strictly elliptical, or, at least, that the observed differences from the elliptic hypothesis are within the limits of the errors of observation; and the length of a pendulum, vibrating seconds in any latitude will be $\overset{\text{Inches.}}{39.0082}$+ (Sin. Lat.)^2 $\times$$\overset{\text{Inches.}}{,2128}$, at 62° Fahr. on Sir Geo. Shuckburgh's Scale.

M. Mathieu has deduced, by means of the theory of Laplace, from the observations of M. Ciscar (with a pendulum without a maintaining power, taken out of the Spanish frigates la Descubrerta and L'Atrevida,) made in nine different latitudes in the northern hemisphere, an ellipticity of $\frac{1}{323,2}$, and from seven observations in the southern hemisphere an ellipticity of $\frac{1}{311,5}$. The mean between these coincides nearly with the results deduced from Clairault's *Theorem* (2d Part, Figure de la Terre,) $\frac{P-\Pi}{\Pi}=2\epsilon-\delta$, from the observations in the Arctic Regions, P representing the polar force, Π the equatorial, δ the true ellipticity, and ϵ the ellipticity of the homogeneous spheroid. That given by Laplace, *Méch. Céles.* Tom. I. p. 102, is $\frac{P-\Pi}{\Pi}+\delta=\frac{5}{2}v$, where $v=$ centrifugal force at the equator, force of gravity being unity. Expressions

which evidently coincide, since in the homogeneous spheroid, $\varepsilon = \frac{5}{4} v + \frac{5}{224} v^2$—&c.

M. Mathieu, after computing the respective errors of the observations of M. Ciscar, from the elliptic hypothesis, observes, "Ces différences sont si petites, qu'elles montrent à la fois le grand accord des expériences entr'elles et avec la théorie ; il n'y en a qu'une que s' élève seulement à deux dixièmes de millimètre ?"

Although these conclusions have not all of them been deduced from absolute measurements of pendulums at the different places, but the lengths computed from the observed difference in the vibrations of the same pendulum, when transported to those places ; yet it fortunately happens the ellipticity does not so much depend on the absolute as the relative lengths, as will be evident on considering the equation expressing the ellipticity. And if the length be known in any given latitude to a tolerable degree of accuracy, by actual measurement, the length in any other latitude may be estimated in terms of this measurement, by the observed difference in the number of vibrations, without involving the errors of measurement.

ART. XII. *A few Facts relating to Gas Illumination.*

THE producing from coal an aëriform fluid, which could be distributed at pleasure in every direction, for the purpose o. economical illumination, has justly been ranked amongst the greatest benefits which the science and enterprise of this country has conferred on mankind.

Important as this discovery was, many defects and inconveniencies have arisen on its adoption; coals contain a large proportion of sulphur, which is volatilized with the gas, and it has hitherto been found impossible to purify it sufficiently for lighting close rooms. The suffocating smell, and the property which it has of tarnishing every thing metallic, exclude its use from dwelling-houses, on account of the injury it would do to our health, our furniture, books, pictures, plate, paint, *&c.* At the same time that the gas which *affords light* is produced from

coal, another gas (hydrogen) is also formed and mixed with it in a large proportion, which on being ignited occasions great heat without adding to the light; these effects render coal gas unpleasant in sitting rooms, and have nearly confined its use to open shops and street lamps.

It is now generally found that the sulphuretted hydrogen which is often mixed with coal gas, very rapidly destroys and stops up the smaller pipes which are used for its conveyance, and much inconvenience and risk is the consequence, especially when it is introduced into buildings. The apparatus necessary for the production of coal gas is very large, expensive, and unmanageable—the purification, imperfect as it is, very troublesome—and the residual matter is peculiarly offensive. This confines its adoption to public companies, or large establishments, thereby materially limiting its utility, and producing an injurious monopoly. The employing of coal instead of oil for the purpose of illumination, has an injurious effect on one of the most important branches of trade a maritime country can possess; and in proportion as coal gas is used, our Fisheries are injured.

About two years since it occurred to Messrs. John and Philip Taylor, that it might be practicable to construct an apparatus capable of converting oil into gas, which would be preferable to coal gas for lighting houses.

In theory, the project appeared easy, and the first experiments were flattering; but, on trying the plan on a more extensive scale, numerous practical and chemical difficulties occurred, which have been removed by considerable labour and expense.

The apparatus is now rendered effective and unobjectionable, and has received the approbation of the first men of science in this and other countries *.

The advantages of oil gas, when contrasted with coal gas, are as follow;—the material from which it is produced containing no sulphur or other matter by which the gas is contaminated, there are no objections to its use on account of the suffocating

* In our next Number we hope to lay before our readers a complete account of the most improved oil-gas apparatus.

smell in close rooms. It does no sort of injury to furniture, books, plate, pictures, paint, *&c.* All the costly and offensive operation of purifying the gas by lime, *&c.*, is totally avoided when it is obtained from oil. Nothing is contained in oil gas which can possibly injure the metal of which the conveyance pipes are made.

The oil gas containing no unmixed hydrogen, (which occasions the great heat of coal gas), there is no greater heat in proportion from the flame of oil gas than from burning oil in lamps, wax candles, *&c.*

The apparatus for the production of oil gas is much less expensive than that necessary to make coal gas; it occupies much less space—it requires much less labour and skill to manage it—it is not so liable to wear and tear, and not so costly to repair as a coal gas apparatus—there are no offensive products to remove, and on its present improved construction it may be introduced into any dwelling-house without nuisance.

The economy of light from oil gas may be judged of from the following data:—

One gallon of common whale oil will produce about 90 cube feet of gas, and an Argand burner will require a cube foot and half per hour to maintain a perfect light; consequently, a gallon of oil, made into gas, will afford such a light for sixty hours, and the expense at a moderate price of oil will be, allowing for coals, labour, &c., not more for one burner than three farthings per hour.

Such a burner will be equal in intensity of light to two Argand oil lamps, or to ten mould candles.

The expense of Argand oil lamps is usually admitted to be about 1½*d.* per hour each.

Supposing 10 mould candles to be burning (at 4 to the lb. will be 2½ lb. costing 2*s.* 11*d.*) $\frac{1}{10}$ part will be consumed in each hour, and the cost of the light is then 3½*d.* per hour.

If wax candles be employed, the expense of a quantity of light equal to a gas burner for one hour, by the same mode of reckoning, allowing a candle to burn ten hours, and taking the price of wax candles at 4*s.* 6*d.* per lb. will cost about 14*d.*

The account will therefore stand thus—

Argand burner oil gas, per hour...... ¼*d.*
Argand lamps spermaceti oil .... 3*d.*
Mould candles .... 3½*d.*
Wax candles.......................14*d.*

In many cases it may be desirable to use a much smaller quantity of light, than such a burner as the one above calculated upon might produce; and instead of the light of ten candles, that of one or more may be given by using burners of a different description, and the expenditure of gas, and the cost, will be reduced in proportion.

The oil gas has a material advantage over coal gas, from its peculiar richness in olefiant gas, which renders so small a volume necessary, that one cube foot of oil gas will be found to go as far as four of coal gas. This circumstance is of great importance, as it reduces in the same proportion the size of the gasometers, which are necessary to contain it; this is not only a great saving of expense in the construction, but is a material convenience where room is limited.

The calculations on the cost of light from oil gas are taken on the usual price of good whale oil; but it is to be observed that cheaper oils will answer the purpose nearly as well, and many of these are often to be procured, and the whole expense may be materially lessened by their use.

In the course of their first experiments, Messrs. John and Philip Taylor were surprised to find that the apparatus they employed gradually lost its power of decomposing oil, and generating gas. On investigation, they discovered that the metallic retorts which had originally decomposed oil and produced gas in abundance, ceased in a very great degree to possess this power, although no visible change had taken place in them.

The most perfect cleaning of the interior of the retort did not restore the effect, and some alteration appears to be produced on the iron by the action of the oil, at a high temperature.

Fortunately the experiments on this subject led to a most favourable result, for it was found that by introducing fragments of brick into the retorts, a great increase of the decomposing power was obtained, and the apparatus has been much improved

by a circumstance which at one time appeared to threaten its success.

A small portion of the oil introduced into the retort still passed off undecomposed, and being changed into a volatile oil, it carried with it a great portion of caloric, which rendered the construction of the apparatus more difficult than was at first anticipated; but by the present arrangement of its parts, this difficulty is fully provided for, and the volatilized oil is made to return into the oil reservoir, from whence it again passes into the retort, so that a total conversion of the whole into gas is accomplished without trouble, or the escape of any unpleasant smell.

The only residuum in the retort is a small quantity of carbon, and the only products besides the gas are a minute quantity of sebacic and acetic acids, and a portion of water—all which are easily separated by passing the gas through a vessel containing water.

The superiority of the light from oil gas over other artificial lights, is fully shewn by its rendering the delicate shades of yellow and green nearly as distinct as when viewed by solar light.

Mr. De Ville, of the Strand, who has made many important experiments and observations on gas illumination, with a view of applying it to light-houses, is inclined to estimate the average produce in gas of a gallon of oil, at eighty cubical feet.

A single jet burner, giving the light of two candles and a half, consumes half a cubical foot of gas per hour.

A double jet consumes three quarters of a foot to give twice the above light, and a treble jet requires one foot.

The light of an Argand burner of coal gas, compared with one of spermaceti oil, may be estimated as 2¼ to one; and of oil gas to coal gas, as 9 to 5.

A curious fact respecting Argand's burners for gas, is, that those with few holes consume a comparatively larger quantity of gas than those having a greater number:—thus,

A burner with 16 holes consumes	2⅛ cubic feet per hour.	
Ditto	12 ditto	2¼ ditto
Ditto	10 ditto	2⅜ ditto

The holes being of the same dimensions in each burner.

On the important subject of coal-gas two treatises have just appeared, which contain much valuable information. One of these is by Mr. Accum, whose former publication is probably well known to such of our readers as may be concerned in this branch of inquiry. The present may be considered as a new work, superseding the former, and abounding in practical details which the author's extended experience has put him in possession of. It is illustrated with seven useful plates.

After pointing out the nature and advantages of the art of procuring light from coal-gas, Mr. Accum gives an account of the different kinds of coal employed in Great Britain, and of their relative value for producing gas; he then treats of the form and dimensions of the retorts, and of the management of the distillatory process. We were here surprised to find so favourable an account of Mr. Clegg's horizontal rotary retorts, a description of which, furnished by that gentleman, will be found in the 2d volume of this Journal. We say surprised, from having been informed of the total failure of the plan at the Westminster gas-works, although erected under the inventor's superintendence; whereas, it now appears to have been carried into execution at Chester, Birmingham, and Bristol, and to be employed at the Royal Mint under the direction of Mr. Accum.

The 8th part of the author's treatise relates to the apparatus, and means of purifying gas; and in the 9th chapter he treats at length of gas-holders, or, as we have generally been in the habit of calling them, *gasometers*. A curious collapsing gas-holder, contrived by Mr. Clegg, is here described, especially applicable in those cases where difficulty attends the construction of a well, or tank, for the usual gasometer to work in. It requires a sheet of water no more than 18 inches deep.

Mr. Accum then proceeds to describe the *gas-metre*, a very curious and useful invention, derived also from the ingenuity of Mr. Clegg. It is a cylinder so constructed as to be kept revolving upon its axis, by the passage of the gas through it, the number of its revolutions depending upon the quantity of gas which goes through its various cavities in a given time; so that if

is a self-acting register, which, if placed between the purifying vessels and the gasometer, shews the quantity of gas generated daily; and if between the gasometer and the mains, it tells the quantity of gas which is consumed by the burners, or otherwise disposed of.

The remaining sections treat of the pipes, burners, and a variety of other minor, but important subjects.

Mr. Peckston's work on gas illumination also abounds in useful details. It treats of the theory of the production of artificial light, the cost of various modes of obtaining it, the natural history of pit-coal, its various combinations and uses, especially in the production of gas. In this volume there are also fourteen useful plates, and the author seems to have attained the object he had in view, that of describing plainly and methodically every part of the gas-light apparatus, so as to enable any one acquainted with machinery to erect such, either for supplying his own premises with gas, or for lighting up manufactories, streets, or towns.

In both these treatises we are glad to find concise, but explicit directions to workmen, for the erection and construction of different parts of the apparatus; with much theoretical knowledge there are abundant practical details; and though Mr. Accum and Mr. Peckston widely differ upon certain minor points, they agree in their principal conclusions. If we understand rightly, Mr. Accum prefers *cylindrical*, and Mr. Peckston *elliptical* retorts. The latter, in his chapter on the *gas-meter*, has discussed, at some length, the title of Mr. Clegg to its invention, and considers the *gas-meter* contrived by Mr. Malam as not only an original invention, but as infinitely preferable, which it really appears to be, to the prior contrivance of Mr. Clegg.

These works on the manufacture of coal-gas will not only be found useful to those who wish to avail themselves practically of their contents, but they abound in statements and information which will probably interest a much more numerous class of general readers.

ART. XIII. *Outline of a Theory of Meteors.* By WM. G. REYNOLDS, *M.D. Middletown Point, New Jersey.*

[The following paper is from the *Quarterly Journal of Science*, edited by Dr. Silliman, at New York. We have republished it in the hope that it may call the attention of our readers to the very interesting and curious subject of which it treats, and in the expectation of its inducing some of our Correspondents to resume the discussion. We do not consider the hypothesis of Dr. Reynolds as the most happy that has been invented to account for the production of meteoric bodies, though it appears to us quite as plausible as the idea that they are of lunar origin, a notion sanctioned by some eminent mathematicians and meteorologists. ED.]

SHOULD the progress of science, for a century to come, keep pace with its rapid advancement for the last fifty years, many appearances in the physical world, now enveloped in obscurity, will then admit of as easy solution as the combustion of inflammable substances, or any familiar process in chemistry, does at this day. Among the many subjects from which the veil of mystery would thus be raised, we may include those luminous appearances in the aërial regions, called meteors, which I am about to consider in the following essay; and which seems to constitute a distinct class of bodies of considerable variety.

Meteors were regarded by the ancients as the sure prognostics of great and awful events in the moral and physical world; and were divided by them into several species, receiving names characteristic of the various forms and appearances they assumed; but of their opinions, as to the physical cause of these phenomena, the ancients have left us nothing solid or instructive. The moderns, more enlightened, have ceased to regard these bodies with the superstitious awe of former ages; but in respect to the cause thereof, are perhaps but little in advance of their predecessors, having, I believe, produced nothing yet that will bear the test of philosophical investigation.

Doctor Blagden (*Philosophical Transactions*, 1784,) considers electricity as the general cause of these phenomena; Doctor Gregory, and others, think they depend upon collections of highly inflammable matter, as phosphorus, phosphorated hydrogen, *&c.*

being volatilized and congregated in the upper regions of the air. Doctor Halley ascribes them to a fortuitous concourse of atoms, which the earth meets in her annual track through the ecliptic; and Sir John Pringle seems to regard them as bodies of a celestial character, revolving round centres, and intended by the Creator for wise and beneficent purposes, perhaps to our atmosphere, to free it of noxious qualities, or supply such as are salutary. Many other theories, as ingenious as fanciful, might be enumerated: but without commenting on their comparative merit, I must acknowledge that none of them have yet impressed my mind with a conviction of their truth. A series of observations, however, have enabled the moderns to ascertain, with apparent accuracy, several particulars relative to these stupendous bodies, which add much to our knowledge of their general character:—their velocity, equal to 30, and even 40 miles in a second of time; their altitude, from 20 to 100 miles; and their diameter, in some instances, more than a mile, are facts we derive from respectable authority, and may aid us, essentially, in forming just conceptions of their nature and properties.

I believe meteoric stones to result from all meteoric explosions; limiting, however, the term meteor, to those phenomena, in the higher regions of the air, denominated fire-balls, shooting-stars, *&c.* That these bodies move in a resisting medium, must be evident to every attentive observer; and that this medium is our atmosphere, is pretty certain, 1st. Because we know of no other resisting medium round the earth; 2dly. Because the same kind of resistance is apparent at every intermediate altitude, from their greatest to their least, which last we know to be far within our atmospheric bounds; and, 3dly. Calculation has, in no instance, assigned them an elevation beyond the probable height of the atmosphere.

That meteors proceed from the earth, that they arise from certain combinations of its elements with heat, and that meteoric stones are the necessary result of the decompositions of these combinations, are opinions I will endeavour to support, by the following considerations.

1st. The properties and habitudes of matter, under certain conditions and combinations.

2dly. The situation of the earth's surface in respect to the sun, the influence of his rays thereon, and the nature of the elements or compounds on which these rays act:

And, 3dly. The identity that exists between the component parts of meteoric stones, and the elements that enter abundantly into the composition of our globe; and, by several other facts and arguments.

Under my first general specification, I will select such principles from the established doctrines of philosophy, as have an immediate bearing on the subject; without engaging in any of those subtle speculations in which certain recondite properties of matter, or the identities of quality and body are affirmed or denied.

Thus, 1st. Heat is the universal cause of fluidity and volatility in bodies; hence no solid can assume the state of gas, until it absorbs, or unites with, a certain portion of caloric; and the subtilty and volatility of compounds thus formed, will be in a due ratio to the quantity of caloric they employ.

2dly. The heat employed to maintain a body in the gaseous state, is said to be latent or fixed, and may be regarded as an ocean or atmosphere of fire, holding the ultimate particles of the body in a state of extreme division, and wide separation, from which they can be driven only by some change in the affinities or condition of the compound.

3dly. If the latent heat in a gaseous compound be suddenly abstracted, as in explosion, its escape is attended with the emission of light and sensible heat, when the volatilized particles held in solution being no longer able to maintain the state of gas, suffer approximation in a due proportion to the quantity of caloric they have lost.

4thly. Caloric, in reducing solids to the state of gas, lessens, but cannot in any case, as far as we know, totally destroy their gravitating force; the diminution of this force, however, being in a direct proportion to the quantity of heat employed.—Hence the following inferences may be fairly drawn, as they seem to be in unison with the relative dependence and harmony existing between the material elements of this globe, and, I believe, are contradicted by no direct experiments; *viz.*, that the expansion of volume, specific

levity, and subtilty of artificial gases, are in a direct proportion to the absolute quantity of caloric they employ; and the caloric is in the same proportion to the insolubility of the substance with which it unites.

5thly. When the specific gravity of bodies on the surface of the earth, is reduced below that of the superincumbent atmosphere, they ascend to media of their own density, in obedience to the laws of aërostatics; thus we raise balloons by filling them with light air, and the carbon of pit-coal and common wood exposed to combustion, and water to the sun's rays, will rise until they reach a medium of like specific gravity with themselves.

6thly. Mechanical agitation and division assist the solution of solids, by bringing fresh portions of the menstruum into successive contact with their fragments, and thus exposing a larger surface.

Under the second head, I proceed to notice the situation of the earth's surface in respect to the sun, &c. The atmosphere is a thin, elastic, gravitating fluid, that completely envelops the earth, to which it may be considered a kind of appendage or external covering; its base, resting on the earth's surface, is of an uniform density, growing rare as it recedes therefrom, in a due ratio to the diminution of its gravitating force, until it is lost in empty space. The atmosphere is estimated on certain data to be about 44 or 45 miles high, but we have good reasons to believe it fills a much wider circle, though too thin to reflect the rays of light above its reputed height.

The earth presents one whole hemisphere to the sun in unerring daily succession; and those parts of it which have the least protection against his rays, will, *cæteris paribus*, suffer the greatest intensity of their action. Within the tropics, the atmosphere opposes less resistance to the sun's rays than in the temperate zones; and in both, large tracts of cultivated land, the summits and sides of great ranges of mountains, margin of oceans, rivers, *&c.*, present an almost naked surface to their influence*. The

* Here we might properly enough notice the high-ways, streets, and pavements of cities, *&c.*, on which the materials being minutely divided

exterior strata of the earth, and especially the more exposed parts thereof, envelop in their compounds elements of an identity of character with those composing meteoric stones.

The atmosphere is the great recipient of all volatilized bodies; it possesses but feebly the powers of a solvent, unaided by heat or moisture, but when these are adjuvants, no body in nature can totally resist their action for a long time.

Now if the above principles are admitted, we have in their application a reasonable solution of most meteoric phenomena. Thus, the rays of the sun darting through the atmosphere reach the surface of the earth, where, by accumulation, they produce sensible heat, which though not intense, is steady and uniform, for many hours every day; minute portions of the earthy and metallic compounds exposed to the sun's influence, will be volatilized by the absorption of heat, and thereby assuming the state of elastic fluids, will ascend until they arrive at media of their own density. The atmosphere in contact, will have some of its particles blended in these compounds, will ascend with them, and to supply the vacuum, new portions of air will rush in and ascend, and the process will continue until the sun's rays are withdrawn, or interrupted by some of the common occurrences of nature.

The utmost height to which these elastic fluids ascend, may be estimated at something more than one hundred miles; and they float at every intermediate distance between their greatest elevation and the clouds, but rarely below the latter, except their course is directed towards the earth in their explosions. They probably ascend at first in small daily detached portions of gaseous clouds, and are diffused over wide regions; but having no sensible resistance opposed to their mutual attraction, they will by the laws of their affinities congregate into immense volumes of highly-concentrated elastic fluids, which on exploding will exhibit all the phenomena of bursting meteors, in the following manner, *viz.*, the latent heat on escaping will manifest itself

by attrition, are in a better state for the sun to act freely on, and will consequently yield greater products than equal areas of undisturbed surface, under like circumstances of heat.

in the form of fire and light, the force with which it strikes the atmosphere, or the rebound of the latter to fill the vacuum, or both, will occasion sound more or less detonating or hissing, as the escape is more sudden, or the atmosphere more dense; the earthy and metallic particles on the escape of caloric, will obey the laws of cohesive attraction, clash together, recover their gravity, and descend to the earth in masses, or shattered fragments.

Meteoric stones frequently bear the marks of violence, which is doubtless owing to the conflict sustained at the moment of explosion; their difference in size depends on the difference or magnitude in the disploding volumes; something like regular arrangement is frequently perceived in the structure of these stones, because in all productions of solid from fluid matter, the consolidating particles possess a tendency to arrange themselves in the order of their affinities. It is thus the various arrangements in saline crystallization, the freezing of water, and cooling of melted metals, may be accounted for. There is a real, as *well as* an apparent difference in the velocity of meteoric bodies; the first arising from their difference of magnitude and the violence of the explosion, as well as from the resistance they meet; the latter, from the different distances at which they are seen. The gradation of colour, from a bright silvery hue to a dusky red, is owing, in a certain degree, to the state of the atmosphere refracting different coloured rays, and also to the materials in the compound, similar to the different hues in artificial fireworks. Reddish and white nebicula are sometimes left in the tracks of meteors, which are nothing but ignited vapours, or the particles brushed off the burning body by the resisting atmosphere. The velocity or motion and direction of meteors, depend upon principles well known and daily practised by engineers, and the constructors of fireworks.

The immediate cause of these explosions is a little obscure, and merits a fuller detail than is compatible with my present limits; their analogy to the electric phenomena in the clouds, leaves room to suppose they are effected by certain modifica-

tions of electricity. Clouds of opposite electricities will approach each other, and explode, by the positive imparting as much electrical fire to the negative cloud as will make them equal, when just as much water as the imparted fire held in solution, will be set at liberty and descend to the earth. If, however, this solution be deemed inapplicable, perhaps the following may be admitted. Thus, when heat is urged upon incombustible * bodies with a force that overcomes the cohesive property by which their particles are tied together, it unites with them in large quantities, and becomes latent, by which union they are reduced to the state of elastic fluids; and as it is a universal property of heat to counteract the gravitating force of bodies, these compounds must necessarily become volant, and ascend as above stated. It is only thermometrical or sensible heat, that destroys the attraction of cohesion existing between the particles of bodies, the repulsive power of latent heat being barely able to counteract this property, when the elements under its dominion are removed beyond a certain distance from each other; now the very reduced temperature in the high regions to which these gaseous clouds will ascend, may admit their earthy and metallic particles within the sphere of cohesive or aggregative attraction, when the caloric will be expelled like water from a sponge, accompanied by all the phenomena above stated.

The third general head of my subject leads me to inquire into the constituent principles of meteoric stones: sundry papers on the analysis of these productions, have been furnished us by chemists of acknowledged reputation and ability, and in none of these that I have seen, was there any element described that had not been previously known. But should it hereafter be found that air stones contain matters not found on our globe, the fact will afford no absolute proof of the foreign origin of these stones, as we are successively discovering earthy and metallic principles of distinct characters from those already known.

A portion of one of these stones that fell in the town of Weston,

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* Perhaps there is no body in nature absolutely incombustible, but I use the term here in common acceptation.

(Connecticut) examined by the late Dr. Woodhouse, gave the following results in a hundred parts, *viz.*

Silex..........	50	
Iron	27	
Sulphur	7	
Magnesia	10	
Nickel	1	inferred from chemical tests.
Loss	5	
	100	

"The sulphur was seen by the naked eye distributed through the silex in round globules the size of a pin's head, after dissolving the powdered stone in diluted nitric acid."

All specimens of these stones do not afford precisely similar results, but differ in their constituent elements and relative proportions; their component parts, however, are to be found abundantly in schist, schorl, pyrites, pebble, granite, *&c.*, on which the sun must daily act*.

The following facts go to strengthen the above theory, *viz.* Meteors are most frequent and stupendous in tropical countries, where the heat of the sun is most intense; and less frequent in our climate in the winter and spring, while, and after the earth has been covered with snow for many weeks in succession; and they are most frequent in the higher latitudes towards autumn, after a continuation of hot dry weather; out of the whole number (179) of shooting stars I have noted during the last twelve years, 149 appeared between June and December, inclusive.

If it be said that the specific gravity of meteoric stones being several times that of water, it is absurd to suppose they can rise, (if even reduced to the state of gas), to the elevated stations here assigned them, seeing the vapours of water can ascend only one or two miles above the earth. To this I reply, that the doctrine of heat is not yet so thoroughly understood, as to acquaint us with all its habitudes with natural bodies, but we infer from analogy, that the more refractory a body is in the fire, the greater

* [Dr. Reynolds here seems to forget *nickel*, which may be regarded as characteristic of meteoric stones. ED.]

in a due ratio is the absolute quantity of heat required to reduce it to, and retain it in, the state of gas; and the greater, in a corresponding degree, will be the dilatation of its particles and decrease of its specific gravity. Hence, if water, reduced to vapour by heat, be capable of assuming an altitude of two miles, it follows that more refractory substances, reduced to a similar state, will suffer expansion and fugacity in a due proportion to the quantity of caloric they employ, and will assume a corresponding elevation, as already inferred under my first head.

Another objection may be, that though high degrees of heat affect certain solids as above stated, yet these cannot be sensibly acted on by such feeble agents as atmospheric air and the rays of the sun. I answer, if it be admitted that sensible heat acts on solids in an increasing ratio to its intensity, it follows that lower degrees, though acting in an inverse ratio to higher, must affect the same bodies in a conceivable degree at any temperature above their natural zero*; and though the heat of the sun beating on a plane surface for several hours is feeble, compared with that produced by a burning lens, or air furnace, yet if it be sufficient to detach from one square foot of the earth's surface the 104023 part of a grain in twenty-four hours, the quantity taken from 100 square miles, in the same time and proportion, would amount to ten pounds, which is abundantly sufficient for all meteoric phenomena; and the loss to each square foot, supposing the process to be uninterrupted, would be no more than one grain in 284 years. When we advert to the intense heat produced by concentrating a few of the sun's rays in a burning lens, the whole quantity daily sent to the earth must strike us forcibly. If collected in a lens of sufficient magnitude, they might volatilize a space equal to the

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* "It may be easily proved that water evaporates (though slowly) at a temperature many degrees below its freezing point; and these vapours are more subtile and elastic than those formed at the boiling point of that fluid.

REMARK.

"It is indeed proved that vapour is formed from water at the lowest temperature, but is *less elastic*, the lower the temperatures, as appears from its sustaining a continually-decreasing column of mercury, the lower the temperature at which the vapour is formed. Vide *Dalton's* and *Gay Lussac's Experiments. Editor.*"

state of New York in a moment of time! As all bodies possess a limited capacity for heat, does it not follow that there must be some outlet to its perpetual accession to our globe, or the earth would soon become so highly ignited as to glow with the fulgour of a meteor? And may not this outlet be found in the above described compounds? which serve as conductors of the surplus of heat from the earth to the higher regions of the air, where on being freed by displosion, from the grosser matters encumbering it, it finds a rapid passage to its great archetype and parent, the SUN. Thus his daily waste may be restored, and an equilibrium, by the return of his own emanated particles, preserved between the sun and the earth, and probably all the planets of our system.

The last consideration I shall offer in favour of the domestic or earthly origin of meteoric phenomena, is the difficulties that present to our granting them a foreign one. Though I am well aware of the respectability of the names which the theory of moonstones can summon to its support, yet I have always regarded it as unfounded and unphilosophical for the following reasons, *viz.* 1st. Whether the moon has an atmosphere or not, we must all admit that she has attraction, which must extend to many thousands of miles from her surface. No projectile force that we are acquainted with can throw a heavy body 100 miles, even though no atmospheric, or other resistance than its own gravity, were present; hence the idea of that force extending to thousands of miles from the moon's surface, is gratuitous and nugatory. 2dly. The products of volcanoes bear no similarity of origin, or kindred resemblance to meteoric stones; those are lavas of different kinds, pumice-stone, scoria, ashes, *&c.* these, solid masses of matter, with some degree of regularity in the arrangement of their constituent particles. 3dly. The descent of these stones has no coincidence in point of time with the position of the moon. She is as often in their nadir as their zenith. We also witness in all cases, explosion and light in our own atmosphere, at the time of the descent of these stones. This could not be the case if they proceeded from the moon, for obvious reasons. 4thly. The heat adequate to such projectile force as

would carry a body from the moon's surface beyond the sphere of her attraction, would volatilize the matter of meteoric stones in a moment; hence they would not be projected from the lunarian crater in solid masses, but in elastic vapour.

In conclusion, although the theory which I have endeavoured to elucidate and establish, be subject to some difficulties and objections which science may hereafter remove, it appears to me perfectly consonant with the relative dependence and harmony of our system, and by no means at variance with the infinite wisdom and power by which it was originated.

Art. XIV. *Cursory Observations on the Geography of Africa, inserted in an Account of a Mission to Ashantee, by* F. Edward Bowdich, *Esq., demonstrating the Errors that have been committed by European Travellers in that Continent, from their ignorance of the African Arabic, the learned and the general travelling Language of those interesting Countries, by* James Grey Jackson, *Esq.*

Page 157. "The Niger after leaving the Lake Dibbir was invariably described as dividing in two large streams."

The Lake Dibbir (vide page 187 of Bowdich's *Account of a Mission to Ashantee*) is called in the proceedings of the African Association, Dibbie, but the proper appellation is El Bahar Tibber, or El Bahar Dehebbie: the Bahar Tibber signifies the sea of gold dust; the Bahar Dehebbie signifies the sea, or water abounding in gold. Jinnee, which is on the shore of this sea or lake, abounds in gold, and is renowned throughout Africa for the ingenuity of its artificers in that metal, insomuch that they acknowledge the superiority of Europeans in all arts except that of gold work. There are some specimens of Jinnee gold trinkets very correctly delineated in the recent interesting work of Lieutenant Col. Fitz-Clarence. (*Journal of a Route across India, through Egypt to England*, page 496.)

Page 187, "Yahoodie, a place of great trade."

This is reported to be inhabited by one of the lost tribes of

Israel, possibly an emigration from the tribe of Judah. Jahooda in African Arabic signifies Judah; Jahoodee signifies Jew.

Page 189, "Mr. Beaufoy's Moor says that below Ghinea is the sea, into which the river of Timbuctoo discharges itself."

This might have been understood to signify the sea of Sudan, if the Moor had not said *below* Ghinea, (by which is meant Genowa, or as we call it Guinea,) which implies that the Neele Elabeed (Niger) discharges itself in the sea that washes the coast of Ghinea; this therefore corroborates Seedy Hamed's, or rather Reichard's hypothesis.

Page 190, "This branch of the Niger, passing Timbuctoo, is not crossed until the third day going from Timbuctoo to Houssa."

This quotation from Dapper's description of Africa is corroborated by L'Hage Abd Salam Shabeeni, whose narrative says, "Shabeeni after staying three years at Timbuctoo, departed for Houssa, and crossing the small river close to the walls, reached the Neel in three days, travelling through a fine populous cultivated country." The confusion of rivers, made more equivocal by every new hypothesis, receives here additional ambiguity. If there were, as Mr. Bowdich affirms there are, three distinct rivers near Timbuctoo, viz. the Joliba, the Gambarro, and the Niger (*i. e.* Neele Elabeed) how comes it that they have not been noticed by *Leo Africanus* who resided at Timbuctoo; by *Edrisi*, who is the most correct of the Arabian geographers; or whence is it that these rivers have not been noticed by the many Moorish merchants who have resided at Timbuctoo, and whom I have questioned respecting this matter*; whence is it that Alkaid L'Hassen Ramy, a captain in the Emperor of Morocco's negro guards, and a native of Houssa, with whom I was intimate, knew of no such variously-inclined streams. This being premised, I

* The Arabs, who form the stata or convoy of the cafilahs or caravans which cross the Sahara, are often seen at Agadeer, and sometimes at Mogodor; and if there were a river penetrating to the north through the Sahara, it unquestionably would have been noticed by them: suca a prominent feature in African travelling as a river of sweet water passing through a desert, could not, I imagine, have failed of being noticed by these people.

am not disposed to alter the opinion I brought with me from Africa the beginning of this century, which is, that the Neel Elabeed is the only mighty river that runs through Africa from West to East; but I admit that its adjuncts have different names, as itself has; thus in the manuscript of Mr. Park's death, a copy of which is inserted in Bowdich's Ashantee, it is called *Kude;* many hundred miles eastward it is called *Kulla*, from the country through which it passes; but Kude and Kulla are different names, and ought not to be confounded one with the other; neither ought Quolla (*i. e.* the negro pronunciation of Kulla) to be confounded with Kude, the former being the negro term for the same river, in the same manner as Niger is the Roman name for the Neel Elabeed.

There is a stream or river which proceeds from the Sahara, the water of which is *brackish*; this stream hardly can be called a river, except in the rainy season; it passes in a south-westerly direction close to Timbuctoo, but does not join the Neel el Abeed. I could mention several intelligent and credible authorities, the report of respectable merchants, who have resided at Timbuctoo, in confirmation of this fact; but as the authorities which I should adduce would be unknown to men of science in Europe even by name, I would refer the reader to the narrative of an intelligent Moorish merchant, who resided at Timbuctoo three years, and who was known to the Committee of the African Association. This travelling merchant's name is L'Hage Abdsalem Shabeeni; and his narrative, a manuscript of which, with critical and explanatory notes by myself, I have in my possession, has the following observation:

"Close to the town of Timbuctoo, on the south, is a small rivulet, in which the inhabitants wash their clothes, and which is about two feet deep; it runs into the great forest on the East, and does not communicate with the Neel, but is lost in the sands west of the town; its water is brackish—that of the Neel is good and pleasant."

Page 190. "Mr. Murray reasonably observes Joliba seems readily convertible into Joli-ba, the latter syllable being merely an adjunct signifying river; this I was also given to understand."

This is an etymological error; the Joliba is not a compound word; if it were, it would be *Bahar Joli*, not Ba Joli or Joliba; thus do learned men, through a rage for criticism, and for want of a due knowledge of African languages, render confused, by fancied etymologies, that which is sufficiently clear and perspicuous.

Page 191. "The river of Darkulla, mentioned by Mr. Brown." This is evidently an error; there probably is no such place or country as Darkulla; there is, howèver, an alluvial country, denominated *Bahar Kulla*, (vide map of Africa, in the new Supplement to the *Encyclopædia Britannica*, p. 88, lat. N. 8°, longitude East 20°.) I apprehend this Darkulla (when the nations of Europe shall be better acquainted with Africa) will be discovered to be a corruption of *Bahár Kulla*, or an unintelligible and an ungrammatical term. Diaar Kulla is grammatical, and implies a country full of houses; Darkulla is an ungrammatical and an incorrect term, and literally rendered into English signifies *many houses*. This being premised, we may reasonably suppose that Bahar Kulla is the proper term; which forms, as I have always understood, the junction of the Neel Elabeed with the Bahar Elabeed, called in the modern maps of Africa, Bahar Elabeade, and hence forming a continuity* of waters from Timbuctoo to Cairo.

191. In this geographical dissertation of Mr. Bowdich, the word Niger is still used, which is a name altogether unknown in Africa, and calculated to confuse the geographical inquirer. As this word is unintelligible to the natives of Africa, whether they be Arabs, Moors, or Negroes, ought it not to be altogether expunged from the Maps? E.

192. In the note in this page, Jackson's report of the source of the Neel Elabeed, and the source of the Senegal, is confirmed by the Jinnee Moors (see Jackson's *Appendix*, to his account of *Marocco*, enlarged edition, p. 311.) It is said that, thirty days from Timbuctoo they eat their prisoners. Does this allude to † Banbugr?

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* See my letter in the *Monthly Magazine*, for March, 1817, page 125.

† The qr in Banbuqr is the Arabic غ. Richardson, in his *Arabic Grammar*, renders this letter gh, which demonstrates that his knowledge

and has not this word been corrupted by Europeans into Banbarra, or Bambarra. See Mr. Bowdich's MS., No. 3, p. 486, (Bambuqr, who eat the flesh of men,) Jackson's translation.

193. The government of Jinnee appears to be Moorish, because Mulai (not Malai) Smaera, signifies, in the Arabic language, the Prince Smaera; the term does not belong to Negroes, but exclusively to Mohammedans. Mulai Bukari (not Malai Bacharroo, which is a Negro corruption of the word,) the race of Bukari, called Abecd Mulai Bukari, is renowned among the Negroes of Sudan; the Negroes of this race form the best troops of the emperor of Morocco's army, and the body-guard, consisting of 5,000 picked men, are exclusively of the Abeed Mulai, or Seedy Bukari; they are well-disciplined troops, and are the only soldiers that can effectually be put in hostile competition with the Berebbers of the Atlas Mountains.

Note, p. 194. Dapper's description of Africa is here quoted in confirmation of the decay of Timbuctoo, and Jackson is accused of extravagance; the latter I shall pass by, it being an assertion unsupported by any substantial testimony, but immediately afterwards is the following passage:

"The three last kings before Billa (*id est*, Billabahada,) were Osamana (*id est*, Osaman, Osamana being the feminine gender,) *Da Woolo*, and Abass. Mr. Jackson says, there was a king Woolo reigning in 1800: and a Moor who had come from Timbuctoo to Comassie ten years ago, (*viz.*, about 1807, or ten years before Mr. Bowdich was in Ashantee,) did not know king Woolo was dead, as he was reigning at the time he left Timbuctoo."

With regard to Dapper's assertion, it should be remembered that, if Timbuctoo was decaying in his time, that is about the period that Muley Ismäel ascended the throne of Morocco, *viz.*, in 1672, it revived very soon after, that is, before the close of the 17th century. This powerful and politic emperor of Morocco had the address to establish and to maintain a strong garrison at Timbuctoo; and, accordingly, during his long reign of 55 years, *viz.*

of Arabic was only scholastic, no practical; it has no affinity whatever to gh. J. G. J.

from 1672 to 1727, Timbuctoo carried on a very extensive trade with Morocco, in gold dust, gum, sudan, ostrich feathers, ivory, *&c.*; and attabas, or cafilahs, or caravans, were going to and from Timbuctoo to Tafilett, Morocco, and Fas, throughout the year: and travelling was then as safe through the Sahara as it is now in the plains of Marocco, or in the roads in England; the only months during which the caravans did not travel were July and August, because the shume, or hot wind of the Desert, prevails during these two months. It is reported that Muley Ismäel was so rich in gold, that his kitchen utensils and the bolts of the gates of his palaces were of solid gold. Timbuctoo continued, with little diminution, to carry on a lucrative trade with Marocco during the reign of the emperor Muley Abdallah, son and successor of Ismäel, and also during the reign of * Seedy Mohammed ben Abdallah, who died about the year 1795, a sovereign universally regretted by his subjects, who was father to the reigning emperor, Muley Solimen ben Mohammed. If, therefore, the trade with Timbuctoo declined in Leo's time, (1570) it unquestionably revived in Ismäel's reign, and also during the reign of his son Abdallah, and of his grandson Mohammed. Since the decease of Mohammed, the trade has declined, because the present emperor's policy leads him to discourage commerce, and to encourage the agriculture and the manufactures of his country, so far as to supply the wants of his own country, and not farther, his political principle being to make his country and its produce sufficient for itself, and as independent as possible of foreign supplies.

Da Woolo is a reverential term, and is synonymous with Woolo, signifying king Woolo.

Park says, Mansong was king of Timbuctoo in 1796, and in 1805, implying thereby that he reigned from 1796 to 1805.

Isaaco says, Woolo was predecessor to Mansong, consequently, according to this, Tew Woolo was king before the year 1796. Mr. Bowdich's Moor left him king at Timbuctoo in 1807; there-

* It should be observed, that an emperor, having the name of the Arabian prophet, is called Seedy; but having any other name, he is denominated Muley, or Mulai.

fore, if Mr. Park's testimony be admitted as correct, Woolo must have been predecessor, and successor to Mansong; otherwise Mr. Park was not correct in saying that Mansong was king of Timbuctoo, in 1796 and in 1805.

Adams says, Woolo was king of Timbuctoo in 1810, and was old and grey-headed. Riley's *Narrative* also confirms his age and grey hair; with regard to my testimony, that *Woolo was king of Timbuctoo in 1800, I had it from two Moorish merchants of veracity, who returned from Timbuctoo in 1800, after residing there fourteen years. They are both alive now, and reside at Fas; their names I would mention, were I not apprehensive that it might lead to a reprimand from the emperor, and create jealousy for having communicated intelligence respecting the interior of this country. I should not have entered into this detail, if the editor of the *Supplement to the Encyclopædia Britannica* (article *Africa*) had not asserted that I have committed an anachronism, in asserting that Woolo was king of Timbuctoo in 1800, thereby insinuating that Park was right and that I was wrong.

Page 195. The editor of Adam's *Narrative* is, I apprehend, incorrect in saying, that the name Fatima affords no proof that the queen, or the wife of Woolo, was a Mohammedan. Fatima is incontestably an Arabian proper name, and it would be considered presumption in a Negress, not converted to Mohammedanism, to assume the name of Fatima. She must, therefore, have been necessarily a Mooress, or a converted Negress; the name has nothing to do with a numeral, and, above all, not with the numeral five, for that is a number ominous of evil in Africa, and as such would never have been bestowed as a name on a beloved wife.

Page 196. Note of W. Hutchinson. "The four greatest monarchs known on the banks of the Quolla are Baharnoo, Santambool, Malisimid, and Malla, or Mallowa." Baharnoo should, as I apprehend, be written Ber Nah, *i. e.*, the country of Noah, the Patriarch; it is called in the maps Bernoo, and the whole passage is calculated greatly to confuse African geography; the

* See my Letter in the *Anti-Jacobin Review*, on the Interior of Africa. Jan. 1818, p. 453.

information is unquestionably derived from Negro authority, and that not of the most authentic kind. Santambool is the Negro corruption of Strâmbool, which is the Arabic for Constantinople. Malisimiel is the Negro corruption of * Muley Ismäel. The first signifies the empire of Constantinople, the second signifies the empire of †Muley Ismäel, who was emperor of Marocco in the early part of the 18th century, and whose authority was acknowledged at Timbuctoo, where he maintained a strong garrison, and held the adjacent country in subjection. This being premised, one of these four great monarchies here alluded to, *viz.*, that of Santambool is not certainly on the Quolla, unless the Quolla be considered the same river with the Egyptian Neele, and that Egypt be considered a part of the empire of Santambool; then and then only can it be said that the empire of Santambool is situated on the Quolla.

Page 198. "Two large lakes were described close to the northward of Houssa, one called Balahar Sudan, and the other Girrigi Maragasee."

The first of these names is a Negro corruption of the term ‡ *Bahar Sudan*, the other is a Negro name of another, if not of the same sea or lake; the situation of the Bahar Sudan is described by me in the Appendix to my account of Marocco, to be fifteen journeys east of Timbuctoo, and the Neel El Abeede passes through it. I have this information from no less than seven Moorish merchants of intelligence and veracity; the same is confirmed by Aly Bey, the Shereef Immhammed, Park, and Dr. Seitzen ¶; all these authorities must therefore fall to the ground, if Mr. Bowdich's report on *Negro Authority* is to overturn these testimonies,

* See the Appendix to Jackson's *Marocco*, chap. 13, p. 295, and Note, 296.

† Muley Ismäel was great grandfather of the reigning emperor of Marocco, Muley Soliman. He established his power in Sudan, and had a strong garrison at Timbuctoo, where his name is still mentioned with reverence.

‡ See Jackson's *Marocco*, enlarged edition, chap. 13th.

¶ For an elucidation of these opinions, see my Letter on the Interior of Africa, in the *European Magazine*, Feb. 1818, p. 113.

which has placed it three degrees of latitude north of the Neel El Abeede, or Neel Sudan, and in the Sahara *, *unconnected with any rivers*. I doubt if any but a very ignorant Pagan Negro (for the Mohammedan Negroes are more intelligent,) would have given the sea of Sudan this novel situation.

Page 200. The Quolla appears to be the Negro pronunciation of the Arabic name Kulla, *i.e.*, the Bahar Kulla, to which the Nile of Sudan is said to flow. Bahar Kulla is an Arabic word, signifying the sea altogether, or an alluvial country, the Neel of Sudan here joins the waters of a river that proceed from the Abyssinian Neel westward, and hence is formed the water communication between † Cairo and Timbuctoo.

Page 201. Quollaraba, or Kullaraba, signifies the Kulla forest as the Negroes express it. The Arabs call it Raba Kulla, *i. e.*, the Forest of Kulla; therefore, if any farther proof of the accuracy of this interpretation be necessary, it may be added that the position agrees exactly with Major Rennel's kingdom of Kulla, for which see the Major's map, in proceedings of the African Association, Vol. I. p. 209. Lat. N. 9°. Long. W. 10.

Page 203. The lake Fittri is a lake, the waters of which are said to be filtered through the earth, as the name implies; the Neel is here said to run under ground. The Moors have a tradition, that the waters of the flood rested here, and were absorbed or filtered through the earth, leaving only this large lake. I never understood this sea to be identified with the Bahar Heimed ‡, *i. e.*, the Hot or Warm Sea; the Hot Sea and the Filtered Sea are distinct waters, the former lays about mid-way, in a right line, between Lake Fittri and Lake Dwi. (See Laurie and Whittle's *Map of Africa*, published in 1813.) This is another inaccuracy of Mr. Hutchison, who appears indeed to have collected information from natives, without considering what title they had to credibility; ano-

* See Mr. Bowdich's Map, in his *Account of a Mission to Ashantee*.

† See Appendix to Jackson's *Marocco*, enlarged edition, p. 313. See also my Letter to the Editor of the *Monthly Magazine*, for March 1817, p. 125.

‡ Heimed is an Arabic term signifying that degree of heat, which milk has when coming from the cow or goat.

ther error is added to the note in p. 203 and 204, *viz.*, what he calls sweet beans are unquestionably dates, which have not the least affinity in taste, shape, growth, or quality, to beans. The Arabic name correctly converted into European letters is *timmer*, not tummer; the African Arabic word designating sweet-beans, is Elfoole el Hellue. The passage, signed W. Hutchison, here alluded to is this: "The Arabs eat black-rice, corn, and sweet-beans, called tummer."

Note, page 204. I do not know whence the *Quarterly Review* has derived its information, respecting the derivation of the word Misr, (a corruption of Massar); the word Massar is compounded of the two Arabic words, Mamother, and Sur of Walls, *i. e.*, Mother of Walls, as Bassora is compounded of the two Arabic words, Ba and Sora, Father of a Wall. Possibly some Arabic professor, versed in bibliographic lore, to favour a darling hypothesis has transmuted Massar into Misr, to strengthen the plausibility of the etymology of Misr from Misraem.

Note, page 205. *Bahar belama* is an Arabic word, importing it to be a country once covered with water, but now no longer so: in the note in this page I recognize the word Sooess to designate the Isthmus of Suez. The Bahar Malee and Sebaha Bahoori are Negro corruptions of the Arabic words *Bahar Elmalah* and *Sebah Baharet*; the former does not apply particularly to the Mediterranean, but is a term applicable to any sea or ocean that is salt (as all seas and oceans assuredly are); the latter term signifies literally the seven seas, or waters; neither is this a term applicable to the Mediterranean, but to any sea supplied by seven rivers, as the Red Sea. These are, therefore, evidently other inaccuracies of Mr. Hutchison. I apprehend Mr. Hutchison's Arabic tutor at Ashantee was not an erudite scholar; the term, and the only term in Africa, applicable to the Mediterranean Sea, is the Bahar Segreer, (literally the Small Sea); and El Bahar Kabeer is the Atlantic Ocean, or literally, the Great Sea; this latter is figuratively called El Bahar Addolon, *i. e.*, the Unknown Sea, or, the Sea of Darkness.

Note, page 206. Is it possible that the author doubts that Wangara is east of Timbuctoo? it should seem that he did, as he quotes Mr. Hutchison as authority for making it to contain Kong,

a mountainous district, many journeys south of the Nile of Sudan. Mr. Park's testimony is also called in support of this opinion, but they are both erroneous. Wangara is as well known in Africa to be east of Timbuctoo, as in England York is known to be north of London. Oongooroo is a barbarous Negro corruption of Wangara; therefore this note, if suffered to pass through the press unnoticed, would be calculated to confuse, not to elucidate, African Geography; neither can it be called, according to Mr. Horneman's orthography, Ungura, the name is ونقارة which cannot with accuracy be converted into any word but *Wangara*. Ungura, Oongooroo, *&c.*, are corruptions of the proper name, originating in an imperfect, and but an oral knowledge of the African Arabic.

Note, page 210. I apprehend the reason why Wassenah was not known at Ashantee by the traders is, because it was out of their trading tract. I have no doubt of the existence of Wassenah, or Massenah, and that it is a powerful country in the interior of Africa, (for where the names of African countries are recorded, we should not be particular about a letter or two, when we find so many orthographical variations are made by different authors); neither is there any reason, that I know of, to doubt Seedy Hamed's account of Wassenah in Riley's Narrative. It is not extraordinary that Wassenah, or Massenah should be unknown at Ashantee, if there were no commerce established between the two places. It is certain that the Africans neither seek, nor care for places, or countries, with which they have no trade or connexion.

It appears well deserving of observation, (for the purpose of rendering Arabic names intelligible to future travellers), that Mr. Bowdich has demonstrated, that what is called in our maps Banbarra, Gimbala, Sego, Berghoo, and Begarmee, being written in the African language with the guttural letter grain, would be quitè unintelligible if pronounced to an African as they are written in our letters; the nearest approximation to the Arabic words would be as follows, taking gr for the nearest similitude that our alphabet will give of the guttural letter grain غ

1. Banbugri ...... بنبغ called in the maps Bambarra.

2. Grimbala ..... غمبدل —— Gimbala.

3. Shogru ...... شاغ —— Sego.

4. Bergru ...... برغوا —— Berghoo.

5. Bagrarmee .... باغرمر —— Begarmee.

The African traveller should be precise in his attention to the sound of these words, otherwise he will be quite unintelligible to the Africans and to the Mohammedans.

Richardson, in his *Arabic Grammar*, is certainly incorrect, when he says the letter غ (grain) should be pronounced gh; no man acquainted *practically* with the Arabic language could be of this opinion, gh having no more resemblance to the sound of the letter غ grain, than g has to h; and every one going to Africa with this erroneous opinion of Richardson, will, undoubtedly, be unintelligible to the Africans.

Finally, the Arabic document, if I may be allowed to call it Arabic, facing page 128, of this interesting work, is a most miserable composition of Lingua Franca, or corrupt Spanish, of unintelligible jargon, abounding in words totally incomprehensible to the Africans, whether Negroes or Arabs; the language is worse, if possible, than the scrawl in which it is written; neither is it a correct translation of the English which precedes it. But purporting to be a letter issuing from the accredited servants of the King of the English, it is certainly a disgrace to the country from whence it issues, and a rare specimen of our knowledge of African languages.

Art. XV. *Chinese Cruelty.*

[The following translation is taken from a periodical publication, issued quarterly from the Missionary press in Malacca, called the *Gleaner*.]

Chinese justice has been a topic of high eulogium; and there is often a reasonable mode of talking, and a plausibility about it, which is now and then very imposing; but the want of

truth and reality in these hypocritical and specious pretences, is shockingly great. In confirmation of these remarks, I beg to submit the following translation of an original document.

"PEKING GAZETTE, AUGUST 9, 1817.

"Chow, the Yu-she (or Censor) of Ho-nan, kneels to report, with profound respect, in the hearing of his Majesty, the following circumstances, and to pray for his sacred instructions.

"The clear and explicit statement of punishments, is a means of instruction to the people; the infliction of punishments, is a case of unwilling necessity. For all courts there are fixed regulations to rule their conduct by, when cases do occur that require punishments to be inflicted in questioning. Magistrates are not, by law, permitted to exercise cruelties at their own discretion.

"But of late, district Magistrates, actuated by a desire to be rewarded for their activity, have felt an ardent enthusiasm to inflict torture. And though it has been repeatedly prohibited by Imperial Edicts, which they profess openly to conform to, yet they really and secretly violate them.

"Whenever they apprehend persons of suspicious appearances, or those charged with great crimes, such as murder, or robbery, the Magistrates begin by endeavouring to SEDUCE the prisoners to confess, and by FORCING them to do so. On every occasion they torture by pulling, or twisting the ears, (the torturer having previously rendered his fingers rough by a powder) and cause them to kneel a long while upon chains. They next employ what they call, the Beauty's Bar *, the Parrot's Beam †, the Refining Furnace ‡, and other implements, expressed by other terms which they make use

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* A torture said to be invented by a judge's wife, and hence the name. The breast, small of the back, and legs bent up, are fastened to three cross bars, which causes the person to kneel in great pain.

† The prisoner is raised from the ground by strings round the fingers and thumbs, suspended from a supple transverse beam.

‡ Fire is applied to the body.

of. If these do not force confession, they double the cruelties exercised, till the criminal dies, (faints) and is restored to life again, several times in a day. The prisoner, unable to sustain these cruelties, is compelled to write down or sign a confession (of what he is falsely charged with) and the case any how is made out, placed on record, and, with a degree of self-glorying, is reported to your Majesty. The imperial will is obtained, requiring the person to be delivered over to the Board of Punishments for further trial.

" After repeated examinations, and undergoing various tortures, the charges brought against many persons are seen to be entirely unfounded.

" As for example, in the case of the now-degraded Taeu-tae, who tried Lew-te-woo, and of the Che-chow, who tried Pĭh-keu-king. These mandarins inflicted the most cruel tortures, in a hundred different forms, and forced a confession. Lew-te-woo, from being a strong robust man, just survived—life was all that was spared. The other, being a weak man, lost his life; he died as soon as he had reached the Board at Peking. The snow-white innocence of these two men was afterwards demonstrated by the Board of Punishments.

" The cruelties exercised by the local magistrates, in examining by torture, throughout every district of Chĭh-le, cannot be described; and the various police runners, seeing the anxiety of their superiors to obtain notice and promotion, begin to lay plans to enrich themselves. In criminal cases, as murder and robbery; in debts and affrays, they endeavour to involve those who appear to have the slightest connexion. The wind being raised, they blow the spark into a flame, and seize a great many people, that they may obtain bribes from those people, in order to purchase their liberation. Those who have nothing to pay, are unjustly confined, or sometimes tortured, before being carried to a magistrate. In some instances, after undergoing repeated examinations in presence of the magistrate, they are committed to the custody of people attached to the court, where they are fettered in various ways, so that it is impossible to move a single inch; and without paying a large bribe, they cannot obtain bail. Their

oppressions are daily accumulated to such a degree and for so long a time, that at last death is the consequence.

"Since there is at this period particular occasion to seize banditti, if there be suspicious appearances, as the age or physiognomy corresponding to some offender described; it is, doubtless, proper to institute a strict inquiry.

"But it is a common and constant occurrence, that respecting persons not the least implicated, who are known to possess property, and to be of a timid disposition, pretences are made by the police to threaten and alarm them. If it be not affirmed, that they belong to the Pih-leën-keaou, (a proscribed sect,) it is said that they are a remnant of the rebels, and they are forthwith clandestinely seized, fettered, and most liberally ill-used, and insulted. The simple country people become frightened and give up their property to obtain liberation, and think themselves very happy in having escaped so.

"I have heard that in several provinces, Chih-le, Shan-tung, and Ho-nan, these practices have been followed ever since the rebellion; and wealth has been acquired in this way by many of the police officers. How can it be that the local magistrates do not know it; or is it, that they purposely connive at these tyrannical proceedings?

"I lay this statement, with much respect, before your Majesty, and pray that measures may be taken to prevent these evils. Whether my obscure notions be right or not, I submit with reve-

IMPERIAL REPLY.

"It is recorded."

I think you will agree with me, Mr. Editor, that the above is a very lamentable state of society. When my Moonshe read this paper, he said, "I knew this was the state of things in Canton, but I never thought it was so in the other provinces; this is what drives people to rebellion; in nine cases out of ten, it is the government causes rebellions." There is, I fear, much truth in the latter part of the old gentleman's remark.

AMICUS.

Art. XVI. *A Note respecting the Operations and Discoveries of* Belzoni *in Nubia. By* Curtin, *an Irish youth who accompanied him.*

As soon as Belzoni had safely deposited the Memnon's head at Alexandria and the statues and other antiquities, discovered at Thebes, with Mr. Salt at Cairo, he set out on his journey to Nubia, with the view of opening the temple of Ipsambul, or Absimbul, situated near the second cataract of the Nile; the account of which, and of its gigantic statues, as mentioned by Mr. Bankes, had excited no ordinary degree of curiosity in the mind of this enterprising traveller.

We were at Philæ on the 5th of June, 1817. The day before we kept in honour of his Majesty's birth-day, for the first time it had ever been kept there. Mr. Belzoni had an inscription cut on this occasion in the upper part of the portico; it is as follows:

> "British colours have been hoisted here, and a royal salute fired, June 4th, 1817, by J. Belzoni and Captain Irby, Mr. Beechy and Capt. Mangles."

Mr. Belzoni and the party hired a boat at this place, and left it for Absimbul; and, passing the island of Kalaptshi (for they did not call there, as the rhamadan was then near at hand,) they made no stay any where, until they arrived at Abusimbul. On their arrival there Mr. Belzoni went to call on the cashief of the place, who was very happy to see Mr. Belzoni, as he expected some present; and Mr. B. had promised him one, on condition that he would not let any one touch the temple, nor take the wood away that he put there to keep the sand taken out from falling in again, which he (the cashief,) did, and kept his word very honourably. For there were some Frenchmen there, and he would not let them have any thing to do with it; so Mr. Belzoni kept his word also, and made him a present of a fowling-piece, and some soap and coffee, things that are very acceptable in that country. On so doing, he asked the cashief, if he could have some men to work in the morning; he said, Yes, by all means; and asked him how many he would want. Mr. B. said, About twenty men. He then left us, and returned to the boat.

The next morning they prepared to work, and Mr. Belzoni made them begin in the same place in which they had formerly left off; but though he succeeded in getting them to work for a few days, until the Rhamadan came on, they then would not work more than two or three hours in the day, and that for a few days only. Mr. B. was determined not to suffer this imposition any longer, for as soon as the *duha*, or twelve o'clock came, they all went away after a leader, who put a white handerchief on the top of a pole, and cried out, " He who is of the faith of Mahomet follow me," and they all immediately did so, and continued for several days so to do; and yet their pay was very great, for they had two piastres a day. The last day Mr. B. told them, that they need not come to-morrow; at which they seemed much pleased, thinking that they were to have the same job the ensuing year. They then went away.

Now, Mr. Belzoni called Mr. Beechy, Capt. Irby, and Capt. Mangles, and asked them if they were willing to work; telling them that he found it impossible to do any thing with the inhabitants, that the Rhamadan was one of the worst times they could have; as the Mahommedan faith prohibited even water from sun-rise t sun-set; and he said also, that they were four, besides the interpreter, and the soldier who was an Italian, and had made himself a Turk, and was very useful to travellers. There was also the cook, who was equally useful, for he was cook, and distilled aqua-vitæ, and made candles; in short, I never met with a man that was so useful to a traveller, for he spoke Italian and English; he is a Copt, and his name is *Girgis.* They all consented to what Mr. Belzoni proposed, and the next morning they went to work, and found that what they had done in four hours, was more than the sixty Barabers had done in one day.

When the Barabers heard what they were doing, they gave orders that, on pain of death, no one should sell any thing to the caffres, or *nusononys* (infidels.) This was a very great check to their proceedings; but Mr. Belzoni had bought some *dourah* at Essouan, for the purpose of making presents to the Nubians, and had also some dates, which he ordered to be boiled, and the dates to be steeped in water, and poured on the dourah. This was their

diet for eighteen days, after which time he found the door (entrance of the temple ?) There had been some disagreement between Mr. B. and Capt. Mangles, on account of taking a different line to get at the door; and Mr. B. would not consent to alter the plans, but followed in the same way he had begun, and, to their great astonishment, soon found he was right, for, in the evening of the 14th day, he discovered the frieze of the door, and on the 16th day they entered, and found it so hot within that they were obliged to retire. Mr. Belzoni took the plan and section of the temple, and then left the place, giving the temple in charge to the cashief, and telling him that he would have some more presents from the consul, and not to let the men throw in the sand again. He promised it should be taken care of, and hoped that the Consul would not forget him. Mr. Belzoni took four statues that he found in the temple, &c. They then returned to Philæ, and afterwards to Thebes, where Belzoni again set about the excavation, during which he found the alabaster sacophagus. I was not with my master at Abissimbul, but he told me all that had happened when he came down to Philæ, where I remained with Mrs. Belzoni, who is a native of Bristol, about twenty-eight years of age.

Art. XVII. *Some of the Questions proposed to* George Bidder, *the Devonshire Boy.*

1. Reduce 1,000,000 farthings to pounds, &c.

Ans. (in 3 seconds) 1041*l.* 13*s.* 4*d.*

2. Reduce 19*l.* 19*s.* 10¾*d.* to farthings.

Ans. (in about 3 seconds) 19,195 qrs.

3. The circumference of the earth being 360 degrees, each degree 69½ miles, what is the number of yards.

Ans. (in 5 seconds) 44,035,200 yards.

4. If the step of a horse be 2¾ feet, and that of a man 2½ feet, how many steps of a man are equal to 40 of a horse.

Ans. (in 7 seconds) 44 steps.

5. If the step of a horse be 2¾ feet, how many steps does he take in going a mile.

Ans. (in 10 seconds) 1,920 steps.

6. If the distance betwixt the sun and the earth be 96,000,000 of miles, now long would a body moving at the rate of $8\frac{1}{2}$ miles per minute be in moving that distance, allowing 365 days to a year.

Ans. 21 years 178 days 3 hours $17\frac{11}{17}$ minutes. (The denominations in which he was desired to give the answers in the short time of 25 seconds.)

7. How many palisades will surround a square piece of ground, whose side is 150 yards, at 10 inches asunder.

Ans. (in 12 seconds) 2,160.

8. Multiply 4444 by 4444.

Ans. (time not observed) 19,749,136.

9. What is the cube root of 51,230,158,344.

Ans. (time not observed) 3714.

10. The difference of two numbers is five, and the difference of their cubes 1685, what then are the two numbers.

Ans. (time not observed) 8 and 13.

11. If the sum of 2 numbers be 11, and the sum of their 5th powers 17,831, what are the numbers.

Ans. (quickly) 4 and 7.

12. Find two whole numbers having 77 for the difference of their squares.

Ans. (very quickly) 38 and 39; but on being told that another answer might be given, was some time in discovering 2 and 9.

13. The sum of 3 numbers is 32, the sum of their squares 350, and the sum of their cubes 3926, what are the three numbers.

Ans. 9, 10, and 13; the time very short indeed for a cubic equation, perhaps about 25 seconds.

14. What is the cube root of 131,872,229.

Ans. 509, (time very short).

15. If the base of a triangle be 5,240 yards, and perpendicular 1956, what is the content in acres.

Ans. $1058\frac{100}{121}$ acres; to this he gave a wrong answer.

16. If the diameter of a globe that weighs 24 pounds be 8 inches, what is the diameter of another globe that weighs 72 lbs.

Ans. 11.538 inches, nearly: this he answered wrong, but complained of being interrupted.

17. Divide 176 into two such parts that their product may be 7663.

Ans. (very quickly) 79 and 97.

18. Divide the same number into two parts whose product may be only half of what it was before, viz. $3831\frac{1}{2}$.

This he said "I cannot answer, it goes too far into fractions:" his idea of a surd!—True answers being $88+\sqrt{3913\frac{1}{2}}$ and $88-\sqrt{3913\frac{1}{2}}$.

19. At a certain election 1296 persons voted, and the successful candidate had a majority of 120—how many voted for each.

Ans. (instantly) 708 and 588.

20. Two travellers set out at the same time from London and York, distant 197 miles, the one travels 14 miles a day, the other 16, how many days will they travel before they meet.

Ans. (instantly) 6 days $13\frac{3}{5}$ hours.

21. A person left 560*l.* between his son and daughter; for every half-crown the son had, the daughter was to have a shilling—what was the share of each.

Ans. (in 5 seconds) 400*l.* and 160*l.*

22. What two numbers are those whose sum is 20, and their product 36.

Ans. (instantly) 2 and 18.

23. The difference of two numbers is 8, and the difference of their 4th powers 14,560, what are the numbers.

Ans. 3 and 11, (in 65 seconds, a short time for a cubic equation.)

24. In how many different ways is it possible to pay 20*l.* in half-guineas and half-crowns only.

Ans. (in 30 seconds) 7 ways.

25. A person wishing to enclose a piece of ground with palisades, found that if he set them a foot apart, he would want 150 more, but if he set them a yard asunder, he would then have 70 to spare—what was the number of palisades.

Ans. 180 (time not observed).

26. Divide 100 guineas among 7 men, and give each man a quarter of a guinea more than another.

Ans. The least share 14*l.* 14*s.* 3*d.* (This stopt him some time, perhaps 4 minutes).

27. Divide 23*l.* 10*s.* 10*d.* among 5 men, 7 women, and 6 boys, and give each man double a woman's share, and each woman double a boy's share.

Ans. A boy 11*s.* 9½*d.*—woman 1*l.* 3*s.* 6½*d.*—man 2*l.* 7*s.* 1*d.*

ART. XVIII. *Dr.* Wilson Philip's *Reply to some Observations relating to his Inquiry into the Laws of the Vital Functions in the last Number of the Quarterly Journal, in a Letter addressed to* W. T. Brande, *Esq.*

Worcester, May 20, 1819.

SIR,

As you have in the last number of the *Quarterly Journal*, which did not fall into my hands until the day before yesterday, inserted a paper relating to some experiments of mine, in which there appears to me to be several mistatements, you will, I am persuaded, do me the justice to insert the following observations in the next number of that work. Why you should say that in the appendix to the second edition of my *Inquiry into the Laws of the Vital Functions*, I have made an attack on the President and Council of the Royal Society, I am wholly at a loss to understand; for I cannot conceive, Sir, that you are actuated by a wish to prepossess the feelings of the reader against me, before you make an appeal to his judgment; nor can I, on the other hand, see any thing in my treatise, which can possibly be construed into an attack on the President and Council of the Royal Society, for whom I have ever felt and expressed the greatest respect; and whose conduct towards me has been calculated to excite no sentiments but those of esteem and gratitude, as I have hinted in more than one passage of the appendix to which you allude.

I had found, from various circumstances there stated, that an implied charge had been brought against me in the Royal Society. I only requested that the President and Council would call on the author of that charge, either to substantiate what he had advanced, or acknowledge his error. A regard for my cha-

racter required this step, and any person who will take the trouble to read the appendix in question, will admit that I did not take it hastily.

Permit me, in the first place, to mention two inaccuracies, which it appears, from the observations in the *Quarterly Journal*, the clerk of the Royal Society must have committed in the account he sent to me of the experiment supposed to invalidate the result of mine. In that Journal it is said, " Dr. Philip in his account of ' the latter experiment has left a blank, where the name of the ' nerves should have been inserted; whereas the words *par* ' *vagum*, were written as plain as any other part of the paper." In the copy sent me *par vagum* is not mentioned, but a blank left, as any gentleman may satisfy himself by requesting a friend here to to inspect it. Mr. Andrew Knight, a distinguished member of the Royal Society, has seen it. In the *Quarterly Journal* it is said, " The manuscript dissertation of Dr. Philip was then re- ' turned to the clerk of the Society, and a minute made during the time of the experiments *was accidentally left in it*." In the clerk's account it is stated, " The following is a copy of a paper " written in a different hand, and *pinned in page* 13, *over part of* " *the account of experiment* 3."

Of the experiment, an account of which was either accidentally left in, or pinned to the corresponding experiment in my paper, the observations in the *Quarterly Journal* give the following account. " When the paper was read before the Society, there were " many members who thought it was right that one of the experi- " ments should be repeated. Three of the members of this " Society undertook this task, one conducting the galvanic part, " another the anatomical part, and the third, who was not made " acquainted which was the galvanised rabbit, was called in after " the experiment was over, to decide upon the stomach in which " the food was most acted upon. That the experiment might be " repeated with the greater accuracy, the paper was put into " these gentlemen's hands, who implicitly followed the directions " contained in it." This is what I have denied, because, for example, in my experiment a continued stream of galvanism was maintained, while in that here alluded to, only occasional contacts

were made between a wire connected with the other end of the battery and the tinfoil in the neck. But it is stated in the *Quarterly Journal* that, "Dr. Philip says that in his experiment there "were muscular contractions produced by the galvanic influence, "which proves that he employed it not in a continued stream, "but by occasional contacts, as in the experiment made by the "members of the Royal Society." The gentlemen who make this statement must, indeed, be unacquainted with the effects of galvanism on the living animal body, when they suppose that a continued stream of galvanism of a certain power, applied as in my experiments, does not occasion a constant repetition of contractions in the neighbouring muscles. Not only the continued stream, but the requisite power of galvanism, was wanting in their experiment; because it requires a much greater power to occasion repeated contractions of the muscles by a continued stream, than by occasional contacts of the metals. The above gentlemen, therefore, so far from repeating the experiment in the way in which I made it, here deviated from it in so important a circumstance, that had their experiment in other respects resembled mine, this deviation alone must necessarily have occasioned a different result.

The observations in the *Quarterly Journal* thus proceed: "These "gentlemen were quite competent to the task, and each confined "himself to his own department; the third, who was employed "to examine the contents of the stomachs, after an accurate in-"spection, was unable to detect the slightest difference between "them. This result was stated to the President, to whom it was "also explained, that the rabbit, which is a species of ruminant, "does not digest its food till it has gone through a previous pro-"cess of maceration, and is therefore not so well fitted for such "experiments as animals that live on animal food." I have, with the assistance of Dr. Hastings and Mr. Sheppard, Physician and Surgeon to the Worcester Infirmary, examined, by killing the animal at various periods of digestion, the stomach of about a hundred and thirty rabbits, and they will attest the accuracy of what I say, when I declare that as far as we could judge from this extensive set of experiments, the results of which are stated at

I am asked, of what the animal died, in six hours, in my experiment quoted in the above Journal, if not of dyspnœa. The reader will find this question answered in the account of experiment 71 of my *Inquiry**.

In the latter part of the observations in the *Quarterly Journal* the authors allude to what they term "The morbid sensibility" of many of the members of the Royal Society, to some of my experiments which were made on living animals; but this sensibility can neither be termed morbid nor unreasonable, if, as I was informed, reports were industriously circulated, that these experiments were not only useless, but that from an erroneous choice of the animal on which they were made, it was impossible they should have been otherwise.

I have now stated the reasons which I believe entitle me to say, that the report of the three gentlemen in the *Quarterly Journal* leaves the statement, in my appendix, exactly where they found it; and indicates a degree of information which but ill accords with the confident style in which they write.

I cannot conclude without adverting to the circumstance of these gentlemen still persisting to conceal their names. This is seldom done on such occasions without a strong motive. I hope theirs is not such as the line of conduct they have for several years pursued, cannot fail to suggest. That three members of so respectable a Society, forgetful of better feelings, the boast of men of science, should combine to depreciate the exertions of an individual, is what I shall be very slow to believe.

I have the honour to be,

Sir,

Your very obedient humble servant,

A. P. W. PHILIP.

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* When I refer to my *Inquiry*, the number of the page or experiment is always that of the second edition.

Art. XIX. *Proceedings of the Royal Institution.*

During the season which has just terminated, four courses of lectures have been delivered in the amphitheatre of the Royal Institution, namely,

1. On the Principles of Experimental Chemistry, by W. T. Brande, Sec. R. S. and Prof. Chem. R. I.
2. On the Steam Engine, and its various improvements and applications, by J. Millington, Prof. Mech. R. I.
3. On Agricultural Implements and Processes, by ditto.
4. On Vegetable Chemistry, by Mr. Brande.

Two Courses of Experimental Demonstrations in Chemistry, have also been delivered by Mr. Brande, in the Laboratory of this Institution; these will recommence, as usual, early in the ensuing month of October, and will be continued during the season, which terminates in June.

The Visitors have made the following Annual Report on the State of the Royal Institution.

"The visitors have this year a most pleasing task allotted to them, in communicating to the members and well-wishers of the Royal Institution, a more prosperous state of their finances than could have been so soon expected. The income of the last year has exceeded the expenditure by £688. 11*s.* 11*d.*, the income being £3,491. 3*s.* 4*d.*, and the expenses only £2,802. 11*s.* 5*d.* The debts were reduced from £2,131. 11*s.* 3*d.*, to £1,667. 10*s.*, and there was a balance in hand of £179. 7*s.* 8*d.*

"They have the additional satisfaction of stating that the present prospect is still brighter.—By the contributions of new members since this account was made up, great progress has been made towards the reduction of the debt; and there is every reason to expect that there will be an opportunity before the conclusion of the present year of entirely discharging it, by applying, according to the intention of John Fuller, of Rose Hill, Sussex, Esq., his

liberal donation of one thousand pounds, mentioned in the last year's Report.

"The next object will be the establishment of a permanent fund, for which purpose it is hoped that zeal and activity will not be wanting in supporting the exertions of the managers, still further to improve their finances, by recommending new members, by promoting benefactions and bequests, and by pursuing such other measures as are likely to be beneficial to so useful an Institution.

"They have likewise to report a donation of upwards of two hundred volumes of valuable books from the collection of the late Mrs. Sarah Sophia Banks, the sister of Sir Joseph Banks, bequeathed by her to Lady Banks, and presented by her Ladyship to the Royal Institution; and in consequence of an augmentation of the number of patrons of the library, and the contributions of new members, the funds appropriated to it are in an increasing state of prosperity; and it is to be hoped that new Patrons will come forward, as well as new Members, to contribute to the further enlargement of this valuable library.

"They have the satisfaction on concluding their report of stating, that all the premises belonging to the Royal Institution are in good repair.

STAFFORD.
GEORGE AUST.
RICHARD HORSMAN SOLLY.
EDWARD CODRINGTON.
HENRY THOMAS COLEBROOKE.
JOHN FULLER.
WILLIAM THORNTON."

The following Books have been presented to the Library of the Royal Institution, from January 1818, *to May* 1819, *inclusive.*

	DONORS.
Cases of Diseased Bladder, *&c.*, 4to. ..	W. Wadd, Esq. Surgeon Extraordinary to the Prince Regent.
An Argument for construing largely the right of an Appellee of Murder to insist on Trial by Battle; and also for abolishing Appeals, 8vo...........	E. A. Kendall. Esq. F.A.S.

The first Centenary of Tables of complete Decimal Quotients..........	H. Goodwyn, Esq. M.R.I.
Sketches of Curvilinear Hothouses, 4to.	Mr. J. C. Loudon.
La Scava; or some Account of an Excavation of a Roman Town in Champagne; with a Journey to the Simplon, 8vo.	The Author.
The 35th Volume of the Transactions of the Society for the Encouragement of Arts, *&c.* 8vo.	The Society.
A Map of Egypt, on two sheets	Lt. Col. W. M. Leake, F.R.S. M.R.I., *&c.*
Observations on some important Points in the Practice of Military Surgery, 8vo..........................	Mr. John Hennen.
Morrison's Chinese Dictionary, 4to.	Directors of the East India Company.
Dialogues and Sentences in the Chinese Languages	
Observations on the Ophthalmic Cases of the Army.....................	John Vetch, M.D.
The Literary Character illustrated....	J. D'Israeli, Esq.
A Memoir of the Life of the Rev. W. Gregor, M.A....................	Dr. Paris, M.R.I. & F.L.S.
Sir George Baker's Medical Tracts....	Sir Fred. Baker, M.R.I.
On Import of Colonial Corn	H. T. Colebrooke, Esq. M.R.I.
L. J. Thenard's Principles of Chemical Analysis	Mr. Arnold Merrick.
Essai sur les Médailles antiques des Iles de Cephalonie et d' Ithaque........	Lt. Col. C. P. De Bosset.
Considerations respecting Cambridge and its Botanical Professorship	Sir J. E. Smith, P.L.S., *&c.*
Considerations on the Colonization of the British Territories in Southern Africa	P. Colquhoun, Esq. M.R.I
Transactions of the Royal Geological Society of Cornwall	Dr. A. Paris, M.R.I. F.L.S.

The Hours; a Poem, by H. Hudson, Esq. .... Panthea; a Tragedy, by W. Benett, Esq.	William Holmes, Esq.
Constantine and Eugene; a Political Dialogue, 12mo.	The Author.
Strictures on the Uses and Defects of Parish Registers................	Dr. G. Man. Burrows, F.L.S.
Episcopacy considered with reference to the modern popular Societies....	The Author.
On the Safety Lamp for Coal Miners, 8vo.	Sir H. Davy, Bart.
Journals of the Academy of Natural Sciences of Philadelphia	The Academy.
Ittiolitologia Veronese, 2 vols. folio....	A. B. Vallé, Esq. M.R.I.
Fœdera, vol. 2, part 1. folio .... Placita de Quo Warranto temporibus Edw. I. II. III., folio .... Rotuli Hundredorum temp. Hen. III. and Edw. 1, vol. 2, folio	Commissioners of the Public Records.
Transactions of the Horticultural Society, vol. 2, part 7, and vol. 3, part 1........................	The Society.
Remarks on Burns and Scalds........	Mr. Nodes Dickinson.
Observations Introductory to a Work on English Etymology	John Thomson, Esq.
Essays on the proximate Mechanical Causes of the general Phenomena of the Universe	Sir Richard Phillips.
Lt. Gen. Thornton's Speech in the House of Commons, 7th May, 1818......	Lt. Gen. Thornton, M.R.I.
Studies of the Historic Muse, 4to. Letters of Yorick in favour of the Established Church	The Author.
La Sainte Bible, par les Pasteurs de Geneve, 8vo. .... Sermon pour la Solemnité du Jeune, 19 April, 1793	Rev. Dr. Abauzit.

On the Mimoses; a Descriptive and Practical Essay, 8vo.	Dr. Marshall Hall.
An English, Hindoo, and Mahomedan Almanack, for 1784	Wm. Cowper, Esq.
The European Magazine, for 1818....	Mr. Asperne, the Publisher
The Repository of Arts, *&c.*, for 1818,	Mr. Ackermann, the Publisher.
Philosophical Transactions, for 1818, part I.	The Royal Society.
Tracts relative to the New View of Society, 8vo.	Mr. Robert Owen.
Enchiridion Romæ: or Remarks on the Buildings, *&c.*, of Rome, 12mo.	The Rev. Step. Weston, F.R.S., *&c.*
Elements of Medical Logic, 8vo.....	Sir Gilbert Blane, Bart. F.R.S., *&c.*
Le Correspondent, ou Collection de Letters d'Ecrivans célèbres de France, d'Angleterre, et autres pays de l'Europe, sur la Morale, la Politique, et la Litterature, 5 tom. 8vo.	Le Chevalier De Sade.
Augusteum: ou Description des Monumens antiques à Dresdé, vol. 3, folio,	Sam. Solly, Esq. M.R.I.
Transactions of the Horticultural Society, vol. 3, part 2.	The Society.
Two hundred volumes of valuable books, part of the library of the late Mrs. Banks,	Lady Banks.
The Youth's Theological Dictionary, 12mo.........................	Mr. E. Dowson.
Views in Sussex, drawn by Turner, engraved by Cooke	John Fuller, Esq. M.R.I.
Dr. Morton's Table of Alphabets......	The Rt. Hon. J. Trevor.
Descrizione dell' Etna, 8vo...........	Abate Francesco Ferrara.
Astronomical Observations made at Greenwich, 1803 to 1816, folio ..	The Royal Society.
Philosophical Transactions, 1818, part II.	The Royal Society.
Memoirs of the American Academy, vol. 4. part I.	The Academy.

A Defence of the Church and Universities of England	Sir J. E. Smith, P.L.S., *&c.*
Scripture compared with itself, in proof of the Doctrine of the Trinity	John Vaillant, Esq.
A Manual of Chemistry, 8vo.	W. T. Brande, Esq. Pr. of Chem. in R.I. *&c. &c.*
The Commemoration of Handel, and other Poems, 8vo.................	John Ring, Esq.
Remarks on Captain Ross's Voyage of Discovery	Capt. Ed. Sabine, R.A.
Elements de Géométrie a trois Dimensions, 8vo..................	M. Hachette, Professeur de l'Ecole Polytechnique.
Second Supplément de la Géométrie Descriptive, 4to.	M. Hachette, Professeur de l'Ecole Polytechnique.
Exposure of the Fallacies contained in the Letter to the Right Hon. Robert Peel, on Paper Currency, 8vo.......	Cha. Wye Williams, Esq.
On the Relation of Corn and Currency.	The Author.
The 36th Volume of the Transactions of the Society for the Encouragement of Arts, *&c*	The Society.
Report of the Committee on the Forgery of Bank Notes	The Society.
The Edinburgh Philosophical Journal, No. I.	The Publishers.
An Essay on the Forces which circulate the Blood, 12mo.................	Chas. Bell, Esq. F.R.S.E.
Proceedings in Parga and the Ionian Islands, 8vo.....................	Lt.-Col. C. P. De Bosset.
The Life of Sir Thomas Bernard, Bart.	The Rev. J. Baker, M.R.I.
A Critical Examination of the First Principles of Geology	G. B. Greenough, Esq P. of Geol. Soc.
M. Dupin's Excursions to the Ports of England, with a Description of the Breakwater at Plymouth, and of the Caledonian Canal, with Notes by the Translator	Capt. Monke, R.N.

A Philosophical and Practical Inquiry into the Nature and Construction of Timber .... Mr. John Lingard.

Several additions have been made, during the last year, to the Mineral and Geological Collection, and a donation for the purchase of Minerals of £10, by John Fuller, Esq.

The following Members have been elected into the Royal Institution, from January 1818, *to May* 1819, *inclusive.*

John Ware, Esq.
John Naylor, Esq.
James South, Esq.
Timothy Bramah, Esq.
Michael Shepley, Esq.
Vice-Admiral Sir Thomas Williams, K.C.B.
The Hon. Henry Verney.
George Watson Taylor, Esq. M.P.
Henry Peckitt, Esq.
Viscount Gage.
Lord John Campbell, M.P.
Robert Holden, Esq.
Robert Farquhar, Esq.
Colonel Leake.
Alexander Russell, Esq.
John G. Campbell, Esq.
Rev. James Baker, Chancellor of the Diocese of Durham.
Edward Bilke, Esq.
Sir Wm. Champion de Crespigny, Bart M.P.
John Nonnen, Esq.
John Nicholl, Esq.
Henry Hallam, Esq.
Captain Wm. Maude, R.N.
Edward Solly, Esq.
Edward Cook, Esq.

Right Hon. Sir Wm. Scott, Knt., Judge of the High Court of Admiralty.
The Hon. Francis Ward Primrose, M.P.
Charles Nicholas Pallmor, Esq.
Thomas Yard, Esq.
Henry James Brooke, Esq.
John Bostock, M.D.
Frederick Perkins, Esq.
Major Charles Bentinck.
Frederick Dize, Esq.
William Evans, Esq. M.P.
Right Hon. Lord Prudhoe.
Sir John Compton, LL.D.

Art. XX. *Proceedings of the Royal Society of London.*

The following papers have been read at the table of the Society, since our last Report.

March 25, 1819.—Some observations on the peculiarity of the tides between Fairleigh and the North Foreland, with an explanation of the supposed meeting of the tides near Dungeness, by Capt. James Anderson, R.N.

On the ova of the opossum tribe, by Sir Everard Home, Bart. V.P.R.S. This paper was illustrated by some very beautiful anatomical drawings from the pencil of Mr. Bauer.

April 1.—Results of observations made at Trinity College, Dublin, for determining the obliquity of the ecliptic, and the maximum of the aberration of light, by the Rev. J. Brinkley, D.D.

Additional remarks on the skeleton of the proteorrhachius, by Sir Everard Home, Bart. V.P.R.S.

On some new methods of investigating the sums of several classes of infinite series, by Charles Babbage, Esq.

April 22.—A case of a blue child, with the dissection, by

Mr. John Freeman Wood, in a letter to W. G. Maton, M.D. (A case of mal-conformation of the heart.)

Observations on the new system of diagonal framing, introduced into His Majesty's navy, by R. Seppings, Esq., by W. Morgan, Esq., communicated by Dr. Thomas Young. In this paper Mr. Morgan gave a concise account of the various advantages resulting from Mr. Seppings's improvements in naval architecture.

MAY 6.—On the optical and physical properties of Tabasheer, by David Brewster, L.L.D *.

* The most important facts contained in this paper, have been already published by Dr. Brewster, in the following extract from the *Edinburgh Philosophical Journal.* "The substance called *Tabasheer* **, has been long known in eastern countries, and formed an important article in the Materia Medica of the Arabian Physicians. In the Gentoo language it is called Vedro-Paloo, or *Bamboo milk*; in the Malabar, Mungel Upoo, or *Salt of Bamboo*; and in the Warriar, Vedroo Carpooram, or *Bamboo Camphor*. It is found in the joints of the female bamboo, sometimes in a fluid state like milk, sometimes with the consistency of honey, but generally in the form of a hard concretion. Some specimens of it are transparent, and resemble very much small fragments of the artificial pastes made in imitation of opal; others are exactly like chalk; while a third kind is of an intermediate character, and has a slight degree of translucency.

"The first person that examined the properties of this substance was Mr. Macie† (now Mr. Smithson,) who analysed a portion of the Tabasheer from Hyderabad, which Dr. Russell ‡ had the preceding year presented to the Royal Society. 'From its indestructibility by fire;—its total resistance to acids;—its uniting by fusion with alkalis in certain proportions into a white opaque mass, in others into a transparent permanent glass, and its being again separable from these compounds entirely unchanged by acids,' he considers it 'as perfectly identical with *common siliceous earth*.'

In the year 1804, Messrs. Humboldt and Bonpland brought with them from America some specimens of Tabasheer called *Guaduas butter* by the Creoles, taken from the bamboos which grow to the west of Pinchincha in the Cordilleras of the Andes.§ These specimens were analysed in 1805,

** "Pliny clearly describes Tabasheer under the name of Sugar. The word is derived from the Persian *Scher*, or the Sanscrit *Kschiram*, signifying milk. See Humboldt *on the Natural Family of the Grasses.*

† "See *Philosophical Transactions*, 1791, p. 368.

‡ "See *Philosophical Transactions*, 1790, p. 273.

§ "Humboldt's *Personal Narrative*, vol. i. Introd. p. xiii. Note.

13.—Upon the different qualities of the alburnum of spring and winter-felled oak trees, by T. A. Knight, Esq., in a letter to the President.

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by Messrs. Fourcroy and Vauquelin*, who found them to be different from the Tabasheers of Asia. Instead of being wholly composed of silex, they contained only 70 per cent. of this earth, and 30 per cent. of potash, lime and water.

"The Tabasheer, which I employed in my experiments, was sent from Nagpore by Dr. Moore to Dr. Alexander Kennedy, who was so kind as to favour me with a considerable portion of it. It had the same general chemical characters as the Tabasheer from Hyderabad, which was used by Mr. Smithson, the same specific gravity nearly, and the same external appearance; so that I have no hesitation in considering it as also composed principally of silex.

"When the semi-transparent specimens of this substance are immersed in water, they imbibe it with great rapidity, emitting numerous bubbles of air. The transparency increases whenever the air has been discharged, and after a few minutes the water pervades, and renders transparent the whole mass.

"If a small portion of water, on the contrary, is laid upon the Tabasheer when dry, instead of adding to its transparency as might have been expected, it actually renders it as opaque and white as chalk; and, from the same cause, the Tabasheer which has been saturated with water becomes opaque, as the water evaporates, reaches its maximum degree of opacity; and recovers its semi-transparency when perfectly dry.

"The increase of transparency from the absorption of water, is an effect easily explained, and is one with which mineralogists have been long familiar in the phenomena of hydrophanous opal; but the production of opacity, by the absorption of a smaller portion of the same fluid which produces transparency, is a fact entirely new and not easily explicable upon known principles.

"After having determined that the white opacity was not the result of any chemical change, and must, therefore, have resulted from optical causes, I attempted to frame some hypothetical explanation of the phenomenon. In tracing the progress of a ray of light through a porous body, having a small quantity of water in its pores, and through another which had these pores filled with water, I saw that opacity could be produced in the first case only upon the supposition that the Tabasheer had a refractive power considerably lower than water. Improbable as this supposition was, I immediately formed one of the semi-transparent specimens into a prism,

* "*Memoirs de l' Institut*, tom. vi. p. 382.

20.—An account of certain experiments made with a view of determining the law of attraction between iron and a magnetic or compass needle, by P. Barlow, Esq., communicated by Colonel W. Mudge.

Art. XXI. *Proceedings of the Horticultural Society.*

Amongst those scientific bodies whose proceedings we intend occasionally to communicate to our readers, there is perhaps none more deserving of notice than the Horticultural Society of London. The objects to which its attention is directed are of the first conse-

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and found, to my great surprise, that the refractive power of Tabasheer was not only lower than water, but so much lower, as to be almost intermediate between water and the gases. I repeated this experiment with various specimens from Nagpore, and also upon one from Hyderabad, with which I was favoured by Dr. Hope, and which, as it formed part of the parcel of which Dr. Russell had presented a portion to the Royal Society of London, was the same as that which was analysed by Mr. Smithson*.

"The following were the results:

		Index of Refraction.
Air		1.0000 +
Tabasheer from Hyderabad, yellowish by reflected light,		1.1115
Tabasheer from Nagpore	Bluish by reflected light,	1.1454
Tabasheer from ditto, harder,	Bluish by reflected light,	1.1503
Tabasheer from ditto,	Bluish by reflected light,	1.1535
Tabasheer from ditto, very hard,	Bluish by reflected light,	1.1825
Water,		1.3358

"The physical properties of Tabasheer are not less singular than its optical qualities, and indicate a structure of a very remarkable kind.

"A detailed account of my experiments on this subject, has been transmitted to the Royal Society of London, and will probably appear in the Second Part of the *Philosophical Transactions* for 1819.

"Edinburgh, *May* 1, 1819."

* "We trust that some of the Members of the Institute of France will be induced to measure the refractive power of the Tabasheer brought from Quito by M. Humboldt, if any of it is still in existence. It will be interesting to know if the 30 per cent. of potash and lime produces any perceptible effect upon the refractive power and other properties of the Tabasheer. I have sent a quantity of the Nagpore Tabasheer to M. Berzelius, with the hope that he may have leisure to submit it to an accurate examination. As this distinguished chemist is now in Paris, he would do a service to science by comparing directly the Asiatic and American Tabasheers."

quence to the welfare of mankind, and the zeal and liberality with which that attention is given, entitle it to the warmest support and unqualified approbation of the nation at large.

Though eminently effective in its operation, the society is comparatively young; nor, until of late, has it obtained that degree of public notice to which it is so justly entitled. We shall, therefore, preface our reports of its proceedings by a brief sketch of its foundation, and the laws by which it is governed.

In the year 1804, a few noblemen and gentlemen, most of them Fellows of the Linnean Society, projected the plan of an institution, whose objects should be strictly horticultural, filling up the space between agriculture and botany. In 1808 they were incorporated by royal charter, under the name of "*The Horticultural Society of London,*" for the improvement of horticulture in all its branches, *ornamental*, as well as *useful*. Since that period, the society has been regularly advancing in numbers and consequence, and at this moment it reckons amongst its members many of the most distinguished personages in the kingdom.

Upon the death of her Majesty, who had honoured the society with her patronage, his royal highness the Prince Regent condescended to intimate his willingness to become its future patron, and expressed his wishes in the warmest terms for the success and permanence of the institution.

We cannot give a more comprehensive view of the nature of the society, than by transcribing the following passages from a statement appended to the list of its members.

"The meetings of the fellows are held on the *first* and *third* Tuesdays in every month, the chair being taken at one o'clock precisely. At these meetings, fruits, vegetables, flowers, and other subjects belonging to horticulture are exhibited; and seeds, cuttings, grafts, and plants procured by, or presented to, the society, are distributed to the fellows present. In addition to these exhibitions and distributions, communications made to the society, on new or important subjects in horticulture, are read, and medals and premiums awarded by the council are presented. Visitors, introduced by a fellow, are admitted to these meetings.

"A selection from the papers read to the society, accompanied

with figures of new or interesting fruits and flowers described therein, is published, under the direction of the council, in May and November, in Parts, forming portions of a quarto volume; these are distributed *gratis* to the fellows, after they have paid their first year's contribution.

"Every candidate for admission into the society is to be proposed by three or more fellows, one of whom must be personally acquainted with him, or with his writings. The certificate of recommendation must specify the name, rank, and usual place of residence of the candidate, who will be ballotted for after the certificate has been read at two meetings of the society. The fee to be paid on the election and admission of a new fellow is three guineas, and the contribution to the society, in each year succeeding his election, is two guineas, provided he shall have been elected *before* the first of October 1818, but if *after* that period, it is three guineas, which charge is payable on the first of May, but may be compounded for by those Fellows elected before the first of October 1818, by the payment of twenty guineas, and by those elected after that period by the payment of thirty guineas at any one time before the contribution of the current year becomes due.

"Any person exercising the trade or profession of a gardener, who shall have received a medal from the society, or shall have communicated a paper, which shall have been printed in the Transactions of the Society, may be elected, and enjoy all the privileges of a fellow, upon the payment of one guinea for his admission-fee, and of one guinea for his contribution in each year. The certificate of recommendation is in the same form, and the election is subject to the same rules as are applicable to that of the fellows."

"There are three other classes of members in the society not subject to payments, from whom the greatest benefit is derived to horticulture; namely, foreign members, whose number is limited to twenty, and which consists of the most distinguished horticulturalists and botanists in all parts of the world. The second class is of foreign corresponding members, consisting of persons eminent for their horticultural pursuits, resident in distant coun-

tries; and the third class is of corresponding members resident in Great Britain and Ireland. These two latter classes are unlimited.

The society has an experimental garden at Kensington, on the south side of the road to Hammersmith, nearly opposite Holland-house, which is open to the fellows of the society, from two to six o'clock in each day of the week, except Sundays. The management of this garden is under the direction of a committee, nominated at the first council, after the anniversary. Fellows visiting the garden have the privilege of introducing one or more friends in their company.

The increasing funds of the society have enabled it to remove to a very commodious house, in which is a spacious meeting-room, in Regent-street, near Waterloo-place, where proper officers are in daily attendance for transacting business.

Having thus stated the objects of the society, and the principles upon which it is founded, we shall, in our future Numbers, record the most important matters which occur at its meetings, commencing with the notice of its proceedings from the anniversary of the society on the 1st of May last.

Art. XXII. *Miscellaneous Intelligence.*

I. Mechanical Science.

§ 1. Astronomy, Mechanics, &c.

1. *Single Microscopes of Glass.*—Mr. Sivright has devised a new method of making single microscopes of high magnifying powers, which is as follows:—Take a piece of platinum foil and make circular holes in it from $\frac{1}{20}$ to $\frac{1}{70}$ of an inch in diameter, and half an inch apart, put pieces of glass into them large enough to fill the aperture. When the glass is melted by a blow-pipe, it forms a lens which adheres strongly to the metal, and is therefore set for use. An eye or loop, made of a piece of platinum wire, may also be used in place of the foil. The pieces of glass used should have no scratch of a diamond or file on them, as a mark remains after being most intensely heated. Of lenses made in this way, those larger than $\frac{1}{70}$ of an inch, were not so good as the

smaller, and the best were less than $\frac{1}{16}$; those which contain air-bubbles must be rejected.

Mr. Sivright has also succeeded in forming plano-convex lens by fusion. A piece of glass was laid upon a plate of topaz, with a perfectly flat and polished natural surface, which is easily obtained by fracture, and the whole exposed to an intense heat. The glass fused, its upper surface became spherical from the attraction of its particles, and the lower flat and highly polished from contact with the plate of topaz.—*Edinburgh Philosophical Journal.*

2. *New Time-keeper of M.M. Breguet.*—M.M. Breguet have formed a piece of mechanism, not larger than a common watch, to be attached to telescopes, for the determination of the time in astronomical observations. This instrument enables the observer to divide seconds of time into tenths with great certainty. The instrument is adapted for the division even into hundredths, but there are few observers sufficiently expert to observe with this degree of accuracy.

3. *Asbestus used in Micrometers.*—Professor Wallace of the Royal Military College, Edinburgh, has ingeniously suggested the application of the capillary crystals of asbestus to the purposes of micrometrical fibres, and Mr. Troughton has successfully practised it. Fibres, about $\frac{1}{3000}$ of an inch in diameter, gave a line beautifully even in the instrument, and considerably opaque. The division of the substance may be carried to any extent.

§ 2. Pneumatics, Agriculture, the Arts, &c.

4. *Resistance of the Atmosphere to falling Bodies.*—M. Benedict Prevost, suggests a new method of demonstrating this resistance, and its superior effect on light bodies. A piece of paper is placed flat on the bottom of a shallow cylindrical box, which is then suffered to fall from any height, the box being arranged so as to descend along the line of its axis, and with the bottom always beneath; in this case the paper will not leave the box, but falls with the same rapidity, the resistance of the atmosphere being removed from it by the box. If a small piece of paper, a bit of down, or a fragment of leaf gold, be placed flat on a large coin, and the coin be allowed to fall, so that it is always beneath, the lighter substance will descend with equal rapidity, and will afford a strong contrast to a piece suffered to float by itself in the air.

5. *Velocity of Sound.*—From the experiments performed lately at San Jago, in Chili, by M. D. Josef de Epinosa, and D. Felipe Bauza, it appears that sound moves with a velocity of 1,227 English feet in a second, the air being at a temperature of 73°,5 Fahr. barometer 27.44 inches.

6. *Spade Labour.*—Mr. W. Crowther, of Somerville Aston, Gloucestershire, states in a late Number of the *Farmer's Journal*, that manual labour by the spade, (so much ridiculed by many) is not only practicable, but profitable; and if more generally adopted, would be the means of finding abundant employment for those who want it. As evidence of the fact, he has this year 110 acres of ley wheat for which the land was prepared by manual labour only, drilling excepted, and a slight harrowing to cover the seed. He has also 30 acres of land which, four years ago, were old unproductive sward; but when labourers became plentiful, he brought the ground into cultivation by manual labour only, and has so continued it ever since, without any beast of draught being employed upon it, except for cartage and to drill and harrow.

7. *Purity of Flour.*—The following directions have been published, as affording means of ascertaining in some degree the purity of flour. 1. Grasp a handful briskly, and squeeze it half a minute, it preserves the form of the cavity of the hand, although it may be rudely placed upon the table. Adulterated flour, on the contrary, soon falls down; that mixed with whiting is the most adhesive, though it soon gives way; but if the adulteration be ground stones, bones, or plaster of Paris, it almost immediately falls. 2. Dip the fore finger and thumb in a little sweet oil, and take up a small quantity of the flour between them; if it be pure it may be rubbed for any length of time, and will not become adhesive, but if whiting be present it very speedily becomes putty, and adheres strongly; the pure flour also takes on a very dark colour from the oil, but the adulterated flour is but little altered in colour. 3. Lemon juice, or vinegar, will also shew the presence of whiting, by the agitation it produces in the flour; pure flour produces no particular effects with these fluids.

8. *Oil from Pumpkins.*—The seeds of pumpkins, which are commonly thrown away, afford abundance of excellent oil, which is said not only to burn well, and give a fine light, but to last longer, and afford less smoke than other oils. The cake remaining after the extraction of the oil may be used as food for cattle, who eat it with avidity.

9. *Russian Spirit Level.*—The Russians make their spirit levels by enclosing the alcohol in a round metallic box, covered by a strong piece of glass, very slightly concave, so as to leave a small bubble of air within. These levels indicate errors in planes supposed to be horizontal, in all directions, without any alteration of the instrument, and are in this respect much superior to the tube levels, which show errors in one direction only. The glass is fixed in the box before the alcohol is introduced which is by a screw hole in the under side of the instrument.

10. *New Substance for Paper.*—The alga marina has again been recurred to in Sweden as a substance applicable in the formation of paper. M. Ehrenhold, of Copenhagen, is the person who has lately discovered a method of working it; and, it is said, that the paper he makes is superior in whiteness and strength to any made from linen rags.

11. *Rupert's Drops.*—A very good method of exhibiting the force exerted by those singular pieces of glass on being broken, is, to immerse them in a phial, or a tall glass, filled with water; on breaking off the end with a pair of pincers, the body of the bulb is rent with such force as infallibly to break the vessel; even a stout wine bottle may be torn asunder by them in this way.

12. *Prize Subject in the Arts.*—The Society for the Encouragement of National Industry in France has offered a prize of 3,000 francs for the discovery of a metal, or composition, of moderate price, which shall not be hurtful to the animal economy, nor oxidizable either by water or the juice of vegetables, or which shall, at least, be much less so than iron and steel, without imparting any colour or taste to the substances in the preparation of which it is employed.

This metal, or composition, must possess hardness and tenacity enough to serve for crotchets, for solid files, for instruments to mash, cut, separate, and divide pears, apples, beet-root, potatoes, and other vegetable productions in common domestic use.

It is required that the inventors reveal the nature of the metals which they may employ in the case of composition, and that specimens of each of these, along with a model of some known machine, by which the necessary experiments for determining the goodness of the principal component parts may be made, shall be deposited with the Society.

The memoirs, specimens, &c., to be lodged with the Society before the 1st of March, 1821, and the prize to be decreed July 1821.

Foreigners may compete, and the Society have published some observations to assist those who are desirous of making researches on the subject.

II. Chemical Science.

§ 1. Chemistry.

1. *On a new Acid of Sulphur and Oxygen, by M.M. Welter and Gay Lussac**.—The acid which will be the subject of this me-

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* The origin of this acid is as follows:—At the time when M. Welter directed a bleaching establishment, he had occasion to act on the oxide of

moir, ranges itself according to the proportions of its elements between the sulphurous and sulphuric acid; but it is far removed from them in its properties and mode of composition, which does not resemble that of any other acid. We shall name it for the present the *hyposulphuric acid*, from its analogy with the hyposulphurous acid; and to recall to mind that it contains less oxygen than the sulphuric, and more than the sulphurous acid. Its saline combinations will be called *hyposulphates*.

The hyposulphuric acid is formed by passing sulphurous acid gas into water holding the peroxide of manganese in suspension; the combination takes place immediately, and a perfectly neutral solution is obtained composed of the sulphate and the hyposulphate of manganese. These salts are decomposed by the addition of barytes in excess, the hyposulphate of barytes being soluble; a current of carbonic acid gas is then passed into the solution to saturate the excess of barytes; and the whole being heated to drive off the excess of carbonic acid which holds a little carbonate of barytes in solution, the hyposulphate of barytes is obtained. That this salt may be perfectly pure, it is advantageous to crystallize it, for otherwise it may contain a small quantity of lime, from which the oxide of manganese is rarely free. By decomposing this salt by the addition of sulphuric acid so as perfectly to saturate the earth, the hyposulphuric acid is obtained.

This acid, even at its highest state of saturation, is inodorous; its taste is sour: it does not appear capable of existing in the gaseous state; exposed with sulphuric acid in an exhausted receiver at the temperature of 10° (50° Fahr.) it was concentrated without being sensibly volatilized; at the density of 1.347 it began to decompose, it gave out sulphurous acid, and retained sulphuric acid.

Heated when very dilute it gave off pure water, but began very soon to disengage sulphurous acid, and sulphuric acid was produced; the heat of a water-bath is sufficient for this decomposition. It is not altered at low temperatures by chlorine, concentrated nitric acid, or the red sulphate of manganese. It perfectly saturates bases, and forms soluble salts with barytes, strontia, lime, oxide of lead, and probably with all the bases. It dissolves zinc without being decomposed, and with the disengagement of hydrogen. It contains two proportions of sulphur, five proportions of oxygen, and a certain quantity of water, which appears essential to its existence, when uncombined with bases. The analysis of the hyposulphuric acid is deduced from the analysis of the hyposulphate of barytes.

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manganese from which chlorine was prepared by sulphurous acid; and he remarked, contrary to the common opinion, that a neutral bi-sulphite was formed, which he supposed to have peroxide for its base. This being communicated to M. Gay Lussac, the result was an examination made by the two philosophers in company, and the discovery of the new acid.

This salt is in shining crystals, having the form of a quadrangular prism, apparently terminated by a great number of facets. It does not suffer any change in the air, nor in a vacuum dried by sulphuric acid; 100 parts of water at 8°.14, (46°.6 Fahr.) dissolve 13.94 parts—this solution is not altered by chlorine. It decrepitates very strongly, a slight heat is sufficient to decompose it, water and sulphurous acid are disengaged, and neutral sulphate of barytes remains. 100 parts of the hyposulphate well dried in the air, lost 29.903 by heat, leaving 70.097 of sulphate of barytes. Another 100 parts of the same salt mixed with chlorate and carbonate of potash, and heated to redness in a platinum crucible, gave, after precipitation with muriate of barytes and washing, 138.3 of sulphate of barytes. This number is not quite twice 70.097, but as it is very difficult to prevent a slight loss of sulphate of barytes during washing, we may admit that the last number ought to contain twice the first. According to this supposition, the hyposulphate of barytes may be considered as formed of one proportion of barytes, one proportion of sulphuric acid, and one proportion of sulphurous acid; and if the proportion of its elements be calculated, taking 50 for the proportional number of sulphuric acid, 40 for that of sulphurous acid, and 97 for that of barytes, it will be found that 100 of the hyposulphate gives 70.12 of sulphate of barytes, instead of 70.097. The quantity of the water is deduced from the difference between the weight of the salt and that of the sulphate of barytes, and sulphurous acid obtained from it. According to this analysis, it is found that the hyposulphate of barytes is composed of

1	proportion of	barytes	97
1	ditto	sulphuric acid	50
1	ditto	sulphurous acid	40
2	ditto	water	22.64;

or

1	proportion of	barytes	97
1	ditto	hyposulphuric acid	90
2	ditto	water	22.64.

Consequently the hyposulphuric acid which neutralizes one proportion of a base, is formed of

2	proportions of	sulphur	40
5	ditto	oxygen	50

and its proportional number ought to be 90

This then is an acid which perfectly neutralizes bases, and the salts of which remain neutral on losing a proportion of sulphurous acid. It contains the same proportion of sulphur as the hyposulphurous acid, and 2.5 as much oxygen. These two acids ought to form a distinct group among the acids of sulphur, and the sulphurous and sulphuric acids will form another. The distinction is necessary, because the quantity of sulphur in each of these groups is different, and because their composition cannot be expressed by terms of the

same series; the salts also of each group have stronger analogies amongst themselves, than they have with those of the other group.

In reviewing the various acids formed by sulphur and oxygen, we have the composition of the

Hyposulphurous acid	2 prop. of sulphur, and		2 prop. of oxygen:	
Hyposulphuric acid	2	ditto	5	ditto.
Sulphurous........	1	ditto	2	ditto.
Sulphuric	1	ditto	3	ditto.

or, if it is desired to preserve the sulphur a constant quantity in all the acids, the oxygen combines with it in the following proportions,—1, 2, 2.5, 3.

But to return to the properties of the hyposulphates. If sulphuric acid, so diluted as not to produce much heat, be poured on one of these salts, nothing particular is observed; but if the acid be concentrated, or the mixture be heated, sulphurous acid is disengaged. This result is easily understood; hyposulphuric acid is permanent at a low temperature, but, as before stated, it is decomposed into sulphurous and sulphuric acids at a temperature slightly raised. The solutions of hyposulphates are unchanged, or at least alter very slowly in the air; in general, all these salts are very permanent at low temperatures, but are easily decomposed when exposed to the action of heat.

The hyposulphate of potash crystallizes in prisms, (cylindroides) terminated by a plane perpendicular to their length.

The hyposulphate of lime is in regular hexagonal plates, generally grouped together in distinct masses.

The crystals of hyposulphate of strontian are very small; they appear to be hexaëdral plates, with edges alternately inclined in contrary directions, similar to those formed on an octoëdron by sections parallel to two opposite faces.

The hyposulphate of manganese is very soluble, and even deliquescent. This property may be advantageously applied in separating the sulphate of manganese formed at the same time with the hyposulphate, when the oxide of manganese is dissolved in sulphurous acid, and then much less barytes is lost in saturating the solution. Indeed other bases may be employed for this object.

The formation of sulphate of manganese in the circumstances of which we have spoken, appears to us deserving of particular researches; but we have, as yet, been able to attend to it only imperfectly. According to the composition of the hyposulphuric acid, and the peroxide of manganese, it appears that nothing should be produced but neutral hyposulphate of manganese, or the sulphate.

The oxide of manganese, prepared with chlorine, gave scarcely any hyposulphate; perhaps the oxide we employed was not at the maximum of oxidation, and that there is in this respect a great difference between the various oxides of manganese. We have not been able to succeed in producing the hyposulphuric acid by treating the hydrated peroxide of barium, and the brown oxide of lead,

with sulphurous acid, though these two oxides present a composition analogous to the peroxide of manganese.

In concluding, we will repeat the essential characters of the hyposulphuric acid, and its salts. The hyposulphuric acid is distinguished from the other acids of sulphur. 1. By its property of being converted into sulphurous and sulphuric acids when heated. 2. By that of forming soluble salts with baryta, strontia, lime, lead, and silver. The characters of the hyposulphates are—1. Solubility. 2. The absence of sulphurous acid when their solutions are mixed with acids, except the mixture heats of itself, or is heated purposely. 3. The liberation of much sulphurous acid at an elevated temperature, and their conversion into neutral sulphates.

Annales de Chimie, tom. x, p. 312.

2. *New Vegetable Alkali, Strychnine.*—At p. 149 of the last volume of this Journal is inserted a note, mentioning the discovery of a new vegetable alkali, by M.M. Pelletier and Caventou. It was then called Vauqueline, but has had its name improved, by being changed into Strychnine. The discoverers have since published a long paper on the subject, in the *Annales de Chimie*, from which the following extracts are made:—

Strychnine is best obtained from St. Ignatius's bean, though it is afforded by some other substances. These seeds are to be reduced to powder by a rasp, and digested in ether, by which a thick oily substance of a faint green colour is obtained, which is transparent when fluid. The ether being withdrawn, the mass is to be treated with alcohol, until all has been extracted that is soluble in that menstruum; this solution is to be filtered cold, and then evaporated, when it leaves a brownish yellow bitter substance, soluble in water and in alcohol. Both this substance and the oil have a very powerful action on animals, similar to that of the bean itself, and due to the strychnine contained in them. To obtain the latter substance pure, a strong aqueous solution of the yellow bitter matter is to be treated with solution of potash; a precipitate falls, which, when washed in cold water, is white, crystalline, and extremely bitter. If not perfectly pure, it may be rendered so by solution in acetic or muriatic acid, and reprecipitation by potash or magnesia; if the latter is used, the strychnine may be taken up from it by alcohol.

Strychnine may be obtained also from the vomica nut, by infusing it in alcohol, and precipitating the clear solution by subacetate of lead in excess; the solution drawn off from the sediment is to be cleared of lead by sulphuretted hydrogen and filtered; then by being boiled with a little magnesia, which abstracts the acetic acid, the strychnine falls, and after being well washed, may be taken up from the excess of magnesia by alcohol, and then evaporation gives it in a pure form.

Strychnine is soluble in alcohol, but nearly insoluble in water. At the temperature of 50° Fahrenheit it requires above 6,000 parts for its

solution; boiling water dissolves $\frac{1}{2500}$ part. Its taste is so powerful, that a solution, containing $\frac{1}{600000}$ part, possesses it in a very marked degree. It changes to blue, vegetable colours that have been reddened by acids, and forms neutral salts with the acids. It may be obtained crystallized in minute quadrangular prisms, terminated by low quadrangular pyramids, from a solution in alcohol, containing a little water, by allowing it to crystallize spontaneously. It has no smell. It acts violently on the animal system. It is neither fusible nor volatile, but is decomposed at the temperature of boiling oil into products, consisting of oxygen, hydrogen, and charcoal.

Sulphate of Strychnine.—This salt, formed by the addition of its two elements, is neutral. It is soluble in ten parts of cold water, and in less of hot water. It may be obtained crystalline by spontaneous evaporation from this solution in small transparent cubes; but if excess of acid be present, the crystals (probably a super salt) are fine needles. The salt is extremely bitter, and is decomposed by all the soluble salifiable bases, strychnine being precipitated. Strong nitric acid added to it gives it a deep blood-red colour. It does not change materially in the air; heated, it loses a little water, then fuses, solidifies, and is decomposed. Its constitution is

Strychnine	90.5
Sulphuric acid	9.5
	100

Muriate of Strychnine.—A neutral salt, more soluble than the sulphate, crystallizing in very fine prismatic quadrangular needles, in mammellated groups; when heated, muriatic acid is disengaged at the moment the base becomes decomposed. Its other properties are in consonance with those of the sulphate.

Phosphate of Strychnine is a perfectly soluble crystallizable salt, the crystals being quadrangular prisms. To obtain this salt perfectly neutral it must be formed by double decomposition, for it is extremely difficult to saturate all the acid by boiling it with excess of strychnine.

Nitrate of Strychnine.—This salt is made by putting strychnine in excess into very dilute nitric acid, heating the mixture, and filtering it, a colourless solution is obtained, which, carefully evaporated, crystallizes in nacreous needles, grouped together in bundles and bunches. This salt is extremely bitter, and acts more powerfully on the animal system than strychnine itself, probably from its solubility. It is capable of uniting to more acid, and if into a concentrated and saturated solution of it a little weak nitric acid be put, the super-salt immediately crystallizes in very fine needles.

When the nitrate is heated it becomes yellow; it afterwards

swells up, carbonizes, and produces a hissing noise similar to the combustion of a piece of charcoal in fuzed nitre, but no light is produced, unless the salt contains excess of acid, and then deflagration occurs.

The action of strong nitric acid on strychnine is interesting. It produces, at first, an amaranthine colour, which changes to blood-red, then to yellow, which deepens more and more, and at last to green; the colour being inversely as the coloured rings of the third order. The same effect is produced by adding nitric acid to salts of strychnine, but then the red colour is more permanent. Heat also assists the action of the acid. Sulphuric or muriatic acid produces the same effect upon the nitrate of strychnine, by liberating the nitric acid, but other acids have not this power.

The change of colour produced by nitric acid on strychnine furnishes a valuable test for the presence of nitrates in mixtures of salts, or in other situations; for this purpose, a little strychnine, or salt of strychnine, is to be added to the suspected mixture with a little sulphuric acid; if a nitrate be present the red colour is produced.

If strychnine, treated by nitric acid until red or yellow, have the excess of acid removed by an alkali or magnesia, the strychnine is obtained of an orange or a yellow colour, with its alkaline powers much diminished, but still capable of forming salts with the acid, which are of a red or a yellow tint, according as it has been brought to the first or second state. If sulphuretted hydrogen is passed through a red combination of strychnine, the colour immediately disappears, and gives place to a perfect white; on heating the fluid the red colour re-appears, if a nitrate of strychnine has been used; but by separating the strychnine from a red solution by magnesia, and combining it with an acid that cannot decompose any nitrate of magnesia that may adhere to it, a red solution is obtained, which, when reduced by sulphuretted hydrogen to whiteness, cannot be re-reddened by heat alone. The proto-muriate of tin also has the power of destroying the red colour of modified strychnine, as does also the proto-sulphate of iron and sulphurous acid gas; and these effects appear to be occasioned by the abstraction of that oxygen which had been furnished by the nitric acid. The discoverers of this substance, therefore, venture the idea, that the red and yellow compounds are protoxides and deutoxides of strychnine.

Carbonate of Strychnine.—The sub-salt may be formed by double decomposition, and exists as a flocculent magma, very slightly soluble in water, but readily so in solution of carbonic acid. The super-carbonate, when exposed to the air, loses its excess of carbonic acid, and the sub-carbonate is deposited in granular crystals.

Acetic, oxalic, and tartaric acids, form neutral salts with strychnine, which are very soluble, and capable of being crystallized. They crystallize more readily when excess of acid is present. The hydrocyanic acid dissolves strychnine, and forms a crystallizable salt, that is not at all injured by evaporation to perfect dryness, being, when re-dissolved, as excellent a test for iron as before.

With sulphur and carbon, strychnine does not appear to form combinations. With iodine and chlorine, however, it exhibits phenomena exactly analogous to those produced by the fixed alcalies. If water, containing iodine and strychnine, be boiled, the colour of the iodine disappears, and the greater part of the alkali is dissolved; when filtered a limpid liquor is obtained, which by evaporation furnishes a white salt, crystallized in needles, in the solution of which it is easy to ascertain the presence of hydriodic acid by concentrated sulphuric acid and by chlorine. It is necessary that excess of the alkali be used for the conversion of the iodine into hydriodic and iodic acids, probably in consequence of its insolubility. Chlorine acts in a similar manner to iodine. When a current of that gas is passed through strychnine diffused in water, it dissolves the alkali, and by spontaneous evaporation perfectly white crystals of muriate of strychnine are obtained. If the fluid is evaporated by heat, it becomes coloured and brown, apparently from the decomposition of the chlorate of strychnine, which is formed with the muriate.

Salts of strychnine are decomposed by potash, soda, barytes, strontian, magnesia, lime, and ammonia, the base being thrown down; it has the power, however, of decomposing most of the metallic solutions, and their decomposition by it may be effected, either by using a weak alcoholic solution of strychnine, or by boiling it with the solution to be decomposed. In some cases it forms triple salts; thus, if boiled with sulphate of copper, oxide of copper precipitates, and the solution becomes of a green colour, and this filtered and evaporated yields long needle-form crystals, of a triple sulphate of strychnine and copper.

M.M. Pelletier and Caventou have mentioned in their memoir a new acid, existing in the seeds in combination with the strychnine. It may be obtained by washing the magnesia by which the strychnine had been precipitated in its preparation, and then boiling it in a large quantity of water. The salt formed by the new acid with the magnesia is dissolved, and its solution, after filtration, is to be evaporated until considerably concentrated, and then treated with acetate of lead. The lead falls in combination with the new acid, and this being acted on by sulphuretted hydrogen, the lead is separated, and solution of the acid obtained. This acid somewhat resembles the malic; when evaporated to the consistence of syrup, and left to itself, it crystallizes in small, hard, and granular crystals. It is soluble both in

water and alcohol. The taste is acid and styptic. It unites to alkaline and earthy bases, forming salts soluble in water and alcohol. Its neutral combination with ammonia does not precipitate the salts of silver, mercury, or iron, but acts upon salts of copper, producing a change of colour, and the deposition of a greenish white salt, of difficult solubility. This acid, on the supposition, though doubtingly expressed, of its being new, has received the name of the *igasuric acid.*

In continuing the analysis of the bean of St. Ignatius, it was found to contain the following principles:—

1. Igasurate of strychnine.
2. Wax in small quantities.
3. Concrete oil.
4. Yellow colouring matter.
5. Gum.
6. Starch.
7. Bassorine.
8. Vegetable fibre.

The paper concludes with an account of some physiological experiments. The principles above named were prepared perfectly pure, and experiments made with them on animals, and the result was, that the strychnine is the only active substance in the nux vomica, St. Ignatius's bean, and *bois de couleuvre**. It was ascertained that the salts of strychnine were more active than the alkali itself, and that there is no substance capable of forming innocuous compounds with it; therefore remedies applied for the effects produced by it, or by the substances containing it, must act directly upon the animal, so as either to expel the poison, or diminish the spasmodic action caused by it, and prevent the injury which arises from that action to the animal.

3. *New Results on the combination of Oxygen with Water, by M. Thenard.*—I have at length been able to saturate water with oxygen. The quantity which it contains in this state is 850 times its volume, or twice that which properly belongs to it. In this state of saturation, it possesses remarkable properties, the most singular of which are the following: Its specific gravity is 1.453, and when poured into common water, it is seen to flow down through it like a syrup, although very soluble. It immediately acts on the epidermis of the skin, rendering it white, and producing smarting, which varies in duration according to the quantity of fluid placed on the skin; if it is considerable, or if fresh portions are added, the skin itself is attacked and destroyed: applied to the tongue, it whitens it also, thickens the saliva, and, with regard to taste, produces an effect difficult to describe, but which resembles that of an emetic. Its action on the oxide of silver is very violent. Each drop suffered to fall into dry oxide of silver produces a real

* Lignum colubrinum, or snake-wood?

explosion, and so much heat is produced that, in a dark place, the evolution of light is very sensible. Besides the oxide of silver, there are several others which act with violence on oxygenated water, as the peroxides of manganese, and of cobalt, the oxides of lead, platinum, palladium, gold, iridium, &c. Many metals, when finely divided, also produce the same phenomena; and, among others, silver, platinum, gold, osmium, iridium, rhodium, and palladium. In all these cases, the oxygen added to the water is disengaged, and sometimes that of the oxide ; but at other times, a part of the oxygen combines with the metal itself, as with arsenic, molybdenum, tungsten, selenium. These metals are acidified frequently with the production of light.

I have again had occasion to observe, very distinctly, that acids render the oxygenated water more permanent. Gold, finely divided, acts with extreme force on pure oxygenated water, whilst it is without action on that containing a little sulphuric acid.

Annales de Chimie. x. 335.

4. *Weight of Water and Air.*—Mr. Rice, in a paper published in the *Annals of Philosophy*, has taken much pains to deduce correctly the weight of a cubical inch of water, and the proportion of the weights of water and air to each other. The results are, that at the temperature of 60° Fahr., and barometrical pressure of 30 inches, 100 cubical inches of dry atmospherical air weigh 30.519 grs.; 1 cubical inch of water weighs 252.525 grs.: the specific gravity of water is to that of air as 827.435 to 1; or, reckoning water as unity, as 1 to .00120855.

5. *On the Specific Heat of Bodies, by M.M. Petit and Dulong.*—M.M. Petit and Dulong have lately been engaged in a series of experiments on heat, which, for their importance and extent, can hardly be too highly appreciated. The prospect there is of still further addition being made to what has already been given to the world by these philosophers, induces a wish to delay a general account of their researches ; but wherever a complete part of their subject has received elucidation, it is of advantage that it should be made known as early and as generally as possible.

The last published researches of these gentlemen have been directed to the specific heat of different bodies. Their mode of determining this was, by ascertaining the times required by different bodies in cooling, through a certain range of temperature. Small quanties of the bodies experimented on were reduced to very fine powder, and enclosed in a small silver cylinder, with a thermometer; this cylinder was placed in the middle of a very thin vessel, blackened on the inside, and covered externally with ice; the air within this vessel was very much rarefied, and the cooling of the body introduced was observed only at temperatures from 5° to 10° above that of the air around it; the height of the mer-

cury in the thermometer was noticed, by means of a glass, with the utmost accuracy. All these precautions were suggested by considerations on the accuracy of the experiments, which are well stated in the original memoir.

The following table contains some of the results of these experiments, and is followed by part of the reasonings of the authors:

Specific Heat*.		Relative weight of the Atoms †.	Product of the weight and capacity of each Atom.
Bismuth	0,0288	13.3	0.3830
Lead	0,0293	12.95	0.3794
Gold	0,0298	12.43	0.3704
Platinum	0,0314	11.16	0.3740
Tin	0,0514	7.35	0.3779
Silver	0,0557	6.75	0.3759
Zinc	0,0927	4.03	0.3736
Tellurium	0,0912	4.03	0.3675
Copper	0,0949	3.957	0.3755
Nickel	0,1035	3.69	0.3819
Iron	0,1100	3.392	0.3731
Cobalt	0,1498	2.46	0.3685
Sulphur	0,1880	2.011	0.3780

The second column contains the relative weights of the atoms of bodies, and is deduced from the proportions observed in the weights of the elementary substances that unite together.

It is easy, by means of the data contained in the above table, to calculate the ratio which exists between the capacities of different atoms. To this end it may be remarked that, in deducing from the specific heats furnished by observation, the specific heat of the particles themselves, it is sufficient to divide the first by the number of particles contained in equal weights of the substances compared. Now, it is evident that the number of particles for equal weights of matter are reciprocally proportional to the densities of the atoms, and therefore the result sought is obtained by multiplying each of the capacities deduced from experiment, by the weight of the corresponding atom. These are the different products contained in the third column of the table.

The mere view of these numbers shews an approximation so remarkable for its simplicity, as immediately to indicate the existence of a law susceptible of being generalized and extended to all elementary substances. In fact, these products, which express the capacities of atoms of different kinds, approach so nearly to equality among themselves, that it is impossible that the differences which may be remarked should not arise from errors, either in the

* That of water being taken as 1.

† The weight of the atom of oxygen being equal to 1.

measurement of the capacities, or the chemical analyses, particularly if it be observed that, in certain cases, the errors arising from these two sources, may be of the same kind, and consequently be multiplied in the results. The number and diversity of the substances on which we have operated, do not permit the relation we have stated to be considered as fortuitous, and we are therefore authorized to conclude the existence of the following law: "The atoms of all the simple substances have exactly the same capacity for heat."

In considering the uncertainty which still accompanies the fixation of the specific weight of atoms, it is easy to conceive that the law we have announced would change its expression, if a supposition different to that which we have admitted of the density of particles were adopted; but this law will comprehend, in all cases, the expression of a simple ratio between the weights, and the specific heats of elementary atoms, and it will be admitted that having to choose between hypotheses equally plausible, we did right to decide in favour of that which gave the simplest relation between the elements we compared. Whatever may be the opinion adopted of this relation; it may henceforth serve to control the results of chemical analyses, and, in certain cases, will offer the most accurate means of ascertaining the proportions of particular combinations.

The law stated appears to be independent of the forms of bodies, provided they are considered under the same circumstances, as may be deduced from the experiments of M.M. La Roche and Berard on the specific heat of gases. Their numbers for oxygen and azote differ very slightly from what they ought to be, to accord with the above law; and the number for hydrogen, which appears small, is so subject to various corrections, that the difference is by no means too great to be considered an error.

M.M. Petit and Dulong then notice the importance of extending the law before stated to the specific heats of compound bodies, but remark, that the difficulties here are still greater than before. The mode of operation is, of course, the same, and equally facile for compound as for simple substances; but the uncertainty in the determination of the specific weight of compound atoms is greater than for simple atoms, and would produce a greater interference. Those philosophers do not give any examples of the specific heat of compound bodies, but observe that, "The observations we have made tend to establish this remarkable law, namely, that there always exists a very simple relation between the capacity of compound atoms, and that of elementary atoms."

"We are able also to deduce from our researches another very important consequence for the general theory of chemical action; it is, that the greater or lesser quantities of heat developed at the moment of combination of bodies, have no relation to the capacity of the elements; and that in the greater number of cases this loss of heat is not followed by any diminution of the

capacity of the compounds which result. Thus, for example, the combination of oxygen with hydrogen, or of sulphur with lead, which cause so great a degree of heat, produce an alteration no greater in the capacities of water and sulphuret of lead, than the combination of oxygen with copper, lead, and silver, or of sulphur with charcoal, produce on the capacities of the oxides of these metals, or the sulphuret of carbon."

Then, after noticing the hypothetical explanations of the production of heat by combination, and their insufficiency, when compared with the above deductions, M. M. Petit and Dulong observe, on the electrical states of bodies, and the theory which supposes the light and heat liberated in combustion, to be produced by the electricity of two bodies in opposite states coming together; and they remark, that the ignition of charcoal by the voltaic battery, and ignition by combustion, present an approach to identity, founded on the strongest analogies, and which deserves to be followed in all its consequences.

6. *On the mode of producing Cold, proposed by M. Gay-Lussac; by Marshall Hall, M. D. F. R. S. E. &c.*—I was much interested in reading the notice given at page 177 of the last Number of the *Journal of Science and the Arts*, of a mode of producing cold, lately proposed in the *Annales de Chimie*, by M. Gay Lussac; partly because the influence of the name of that eminent philosopher will obtain for this experiment the attention it deserves; and partly because I myself proposed the same method in a letter addressed to Mr. Nicholson, and inserted in his Journal, six years ago*.

I think it may not be amiss to transcribe the letter to which I allude. It is conceived nearly in the same terms as the notice of the mode proposed by M. Gay Lussac, and is as follows:—

"The diminution of temperature observed during the exhaustion of the receiver of the air-pump, appears to suggest a principle on which the degree of artificial cold may be very much increased. The cold produced in this way appears to be proportionate to the degree and rapidity of the rarefaction of the air contained in the receiver; to increase the quantity of rarefaction, therefore, would be to increase the intensity of the cold. The quantity of rarefaction will be measured by the difference between the density of the air employed, before and after the experiment; the denser the air is before, and the rarer afterwards, and the greater the rapidity with which the change is effected, the more intense will be the cold induced.

"To generate artificial cold, it is proposed that a cylinder be filled with air, which is, by means of an accurate piston, to be subjected to a very strong pressure. The cylinder and contained

* Vol. xxxv. page 117.

air are to be cooled as much as possible, by the best frigorific mixture, and in this state the air is to be allowed to escape through an orifice into a large exhausted receiver. Any substance contained in the cylinder, or exposed to the stream of air expanding in the receiver, will have its temperature very much reduced; and as the air may be compressed to an indefinite degree, it would appear that there would be *no limit* to the degree of cold which might be produced in this manner."

I may now add, that it would be desirable that the rarefaction of the condensed air, should take place in *one* vessel only, as the effect would otherwise be *divided;* and that the principle of the rarefaction of air, might be advantageously employed *conjointly* with those of the freezing mixture, and of the elegant experiment of Mr. Leslie. It might also be well to *reverse* the experiment in which tinder is set on fire by the compression of air.

By these means an intensity of cold might certainly be produced, far greater than any to which chemical substances have hitherto been exposed; and some changes of form may perhaps be effected in several bodies, which we at present can only anticipate, as probable results of exposure to a very intense degree of cold.—*Nottingham, May* 1, 1819.

7. *Evolution of Light by the Expansion of Oxygen.*—A very curious and important experiment has recently been made by M. Biot. It consists in breaking, by means of a suitable apparatus, a ball of glass filled with oxygen gas, and placed in the receiver of an air pump, in which as perfect a vacuum as possible has been formed. The effect is to produce in a dark room a brilliant light.—*Edinburgh Philosophical Journal.*

8. *Pyrometrical Gauge.*—An imperfect but sometimes very convenient instrument to judge of the action and state of a wind furnace when in use, may be made by inserting a syphon gauge into the flue at a little distance above the fire, and filling it with water, the difference between the level of the water in the two legs of the syphon, indicates the exhaustion within and pressure inwards; and for the same furnace and fuel this will always be nearly as the air which passes through the fire, and consequently as the heat in the body of the furnace. Notwithstanding that the furnace with which I have used this instrument is an old one, and from frequent use has its walls cracked, and the various parts belonging to it warped so as not to fit accurately, by which means much air is admitted into the flue without passing through the fire: still the pressure on the gauge is equal at times to half an inch of water; and by inclining the limbs of the gauge so as to make it form an obtuse V, a scale much more extensive than this may be obtained.

I can ell with considerable certainty, by noting the pressure in

this syphon gauge, when steel or iron within the furnace is in good fusion, and also when there is danger from the rising of the heat that the Hessian crucible may run; and the instrument in connexion with appearances of other kinds, has been of great use to me. It is evident that its value is derived only from practice, and that it cannot be applied with the same scale to any furnace indifferently, but in the absence of better means it may be worth attention, and particularly as it causes no trouble, and is observed with the utmost facility.

It may be remarked here, that the ascending power of the column of air in the chimney of this furnace, and which is 63 feet high, is, when the furnace is working well, equal to about $\frac{4}{5}$ of an inch of water; and that when the momentum of the moving column is added to this, it rises up to a full inch of water. M. F.

9. *Detection of Lithia.*—M. Berzelius gives the following process as a test for lithia in minerals. A fragment of the mineral, the size of a pin's head, or a small quantity of its powder, is to be heated with a little excess of soda on a piece of platinum foil by a blow-pipe, for a couple of minutes. The stone is decomposed, the soda liberates the lithia, and, the excess of alkali preserving the whole fluid at this temperature, it spreads over the foil, and surrounds the decomposed mineral. That part of the platinum near to the fused alkali becomes of a dark colour, which is more intense and spreads over a larger surface in proportion as there is more lithia in the mineral. The oxidation of the platinum does not take place beneath the alkali, but only around it, where the metal is at the same time in contact with air and the lithia. Potash destroys the re-action of the platinum on the lithia, if the lithia is not abundant. The platinum resumes its metallic surface after having been washed and heated.

10. *Action of Carbonic Acid Gas on Fruits, and the formation of Alcohol in them.*—M. Dumont, of Paris, in a letter to Count Chaptal, published in the *Annales de Chimie*, describes a considerable formation of alcohol in fruits placed in an atmosphere of carbonic acid gas. The fruits were cherries of various kinds, as the black, the sour, the hard, and those which in France are called the English cherries; they were placed in tin vessels, which were filled with carbonic acid, obtained from marble and acid; they were then (badly) corked, and placed in a cellar. They had not changed in fifteen days, but after that time, a fluid collected in the bottom of the vessels, and the fruit began to change. At the end of six weeks, a strong alcoholic odour was perceived at the apertures of the vessels; the sour cherries had lost their colour, and resembled, in the hardness of the pulp, its adherence to the kernel, and, in taste, cherries preserved in brandy,

so completely, that many persons mistook them for such in reality.

The hard cherries had altered in various degrees, some were whole, some had sunk into a soft paste; 12 lbs. of them being distilled, yielded about 6 ounces of alcohol, of 25 degrees*.

Grapes treated in the same way gave similar results. The vessels were closed by bladders tied tight over them, and the consequence was, that from the liberation of a gas, one of them burst; a small aperture being made into the other vessels, the fruits within underwent their change without producing inconvenience.

4 lbs. 12 oz. of pears, treated in the same way, had in ten weeks time produced much fluid matter in the vessel, and being distilled yielded 4 oz. of alcohol, of 19 degrees. (Sp. Gr. 935.)

Chesnuts, placed in the gas for fifteen days, had contracted an alcoholic taste, which they retained even after being boiled; others when roasted had a taste like that of a hazel-nut. They were perfectly preserved, whilst another portion of the same chesnuts, that had not been placed in the carbonic acid gas, were very soon spoiled.

11. *On the Preparation of Sulphuret of Antimony.*—The usual mode of separating sulphuret of antimony from its matrix, namely, by fusion, has been objected to by M. P. Berthier in France, on the ground that, though it appears simple in its nature, and facile of execution, it is nevertheless more expensive than the processes adopted with other ores. In the process of fusion there is much loss of sulphuret from the quantity which remains in the refuse of the matrix from that which is sublimed, from the adhesion of part to the crucibles, and from the breaking of pots in the furnace, and these, when united, make up a loss which is a heavy tax upon the process. At Licouln, in the department of la Haute Loire, where M. Berthier made many experiments on the subject, the loss amounted to one-fifth of the whole weight of the sulphuret.

M. Berthier then proposes the method of washing for the separation of the sulphuret from its matrix, and advances some experiments of the kind made in a small way, which were very successful. The method, however, appears to be applicable with advantage only when the ore is of a poor quality; when very rich, as there is then much less comparative loss by the mode of fusion, it may not be inferior to the other; but when the mineral does not contain more than ½ of sulphuret, the process of washing seems very much superior, the expense of preparing the same weight of sulphuret is smaller, more of it is obtained from the same weight of ore, and, further, an ore so poor that it is not worth working by the mode of fusion, may in this way be turned to good account. *Annales des Mines*, 3, p. 555.

* If of Baumé, equal to specific gravity, 897.

12. *Subcarbonate of Potash.*—M. Guibourt, in preparing the subcarbonate of potash from a mixture of nitre, and cream-of-tartar, has observed the abundant formation of a cyanuret of potash. The mixture used was one part of nitre and two parts of cream-of-tartar; it was projected by portions into a red-hot crucible, and then heated until fused; this fused mass, when dissolved, gave the hydrocyanate of potash, and which could be destroyed only by exposure for a long time to the air. It is remarkable that, on throwing the same mixture into a crucible, scarcely red-hot, and after the deflagration preventing the further accession of heat, the mass when cold yielded a subcarbonate of potash, perfectly free from either a nitrite or a cyanuret.

13. *Alloys of Platinum.*—Mr. Fox of Falmouth has made known in the *Annals of Philosophy* some very remarkable instances of the force with which different metals combine. If about equal bulks of platinum and tin be heated to redness, in contact with each other, they will combine suddenly with great vehemence, and a very considerable extrication of light and heat, which will continue for some time after their removal from the fire. The experiment is easily made, by enveloping a little bit of tin in platinum foil, and heating it by a blow-pipe on charcoal, a sort of explosion takes place at the moment they combine, and the alloy runs about burning like ignited antimony.

The same effects took place with platinum and antimony. This alloy, when highly heated for a length of time, became solid, and very malleable, and contained little else than platinum.

Zinc also produced these phenomena in a very brilliant manner, exploding and burning at the moment of combination. Mr. Fox attributes the heat produced to the inferior capacity of the alloy, when compared with the metals, but the effect appears principally to be the results of the strong affinities brought into action in these experiments.

14. *Palm Wine.*—Some palm wine has lately been brought into this country from Cape-Coast Castle, under the direction of Captain Bagnold. This fluid, when fresh, is of the colour and consistence of milk; it is very sweet, is not inebriating, and is drank as a luxury by the natives and Europeans. When exposed to the air for a few hours it becomes slightly acid, and very intoxicating. That which Captain Bagnold possessed, and which he gave me for examination, had been obtained by tapping from the tree, Jan. 1, 1818, and it was first opened in London, April 1819.

It came in a stone-bottle, badly corked, but sealed up. When the bottle was opened it had a smell like that of fermenting beer, and the atmosphere within the bottle contained so much carbonic acid that, poured into a glass, it extinguished a taper within it The wine was a thin, milky, aqueous fluid. It was very sweet

and somewhat acid; it acted readily on litmus paper, and contained both carbonic and acetic acids. When the wine was placed on a filter, it slowly passed through perfectly pellucid, leaving the white insoluble part on the filter. This, when heated in a tube, gave off abundance of ammonia, and appeared to be vegetable albumen; the clear fluid was rendered opaque, by the addition of alcohol, and the precipitated matter, on separation, was found to be gum.

Eight ounces of the wine were taken as from the bottle, and carefully distilled with a little pounded marble, until 4-5ths had come over, and this, made up to the original quantity by pure water, gave an alcoholic solution of specific gravity, 993.7, at 55° Fahr. equal to 4.7 per cent. of alcohol, by Gilpin's Tables.

The portion left in the retort was separated from the marble, and evaporated until like a syrup; alcohol was then added, which formed a sweet brown solution, and left an insoluble matter, which, dried at 212°, weighed 20 grains. It was partly soluble in water, and resembled a mixture of gum and albumen.

The alcoholic solution deposited some very minute crystals, which were supertartrate of potash, and then, being evaporated at 212° to dryness, gave a hard brown cake, weighing 167 grains, which was principally sugar. An accident prevented any experiments on the quantity of salts contained in this portion of the wine, and, with the exception of a very minute quantity, no more was to be obtained.

M. F.

15. *Analysis of the Liver.*—M. Braconnot has lately analyzed the liver of an ox with the following results: 100 parts gave,

Vascular tissue and membranes	18.94
Parenchyma	81.06
	100.

100 parts of the parenchyma, or proper substance of the liver, contained,

Water	68.64
Dried albumen	20.19
Matter with little azote, soluble in water, and slightly so in alcohol	6.07
Phosphuretted oil, soluble in alcohol, and analogous to that of the brain	3.89
Muriate of potash	.64
Ferruginous phosphate of lime	.47
Acid salt insoluble in alcohol, formed of a combustible acid with potash,	.1
Small quantity of blood	
	100.

16. *Caseic Acid and Caseous Oxide.*—M. Proust has published, in a late number of the *Annales de Chimie*, some researches on the fermentation of gluten and the curd of milk, in which he describes two new substances, the product of these fermentations, a combustible acid and a combustible oxide; and in consequence of their existence in cheese, being the substances which give it flavour, he has named them the caseic acid and the caseous oxide.

When gluten is placed under water, in a temperature of 50° Fahrenheit, it undergoes a change, swells in volume, and liberates much gas. A pound of gluten, which occupied a volume of thirty-six cubical inches, after some days gave out eighty-five cubical inches of gas, of which forty-eight were carbonic acid gas *, and thirty-seven pure hydrogen. After the gluten had suffered this change it was broken down, and put into a bottle containing water enough to cover it a few inches, and the mouth of the bottle closed by a glass plate; no more gas was liberated, but acetic, phosphoric, and *caseic* acids were produced, all of them saturated by ammonia. If during this spontaneous action of the elements of the gluten the water is allowed to evaporate, the decomposition ceases; but if the mass is retained in a moist state, the products above-mentioned continue increasing until the water above the gluten is so much charged with them as to become a sort of brine, sufficiently strong to prevent any further change. In this case the fluid should be withdrawn, the gluten should be washed and replaced in water, for the continuance of its decomposition, and the formation of more of these products.

The fluid and the washings are to be evaporated carefully in a silver basin, during which much carbonate and acetate of ammonia separates, until a thick syrup is obtained, and this left to itself for a few days solidifies into a saline mass, slightly transparent, and having an extremely acrid and unpleasant taste of cheese. This mass is to be covered with alcohol and agitated with it; the whole becomes turbid, and an abundant white powder separates which is to be washed with alcohol, until deprived of any cheesy taste. This is the *caseous oxide.*

The caseic acid, combined with ammonia, is taken up by the alcohol, together with other substances; the solution is to be put into a narrow bottle, or flask, and every two days two ounces of very pure alcohol is to be added; this causes the separation of a portion of gum, in the form of a fluid, from which the supernatant fluid is to be poured; and, on being distilled, a saline mass is obtained, free from gum, and consisting of carbonate, acetate, phosphate, and caseate of ammonia. To separate these the

* This, of course, could not be all the carbonic acid gas liberated by the gluten, as the experiment was made over water.

mass is to be dissolved in water, and boiled with two ounces of carbonate of lead, free from lime; in this way the ammonia is dissipated, and the acids form salts with the lead; on making a solution and filtering, the phosphate remains behind, and the filtered liquid contains acetate and caseate of lead only. A current of sulphuretted hydrogen is now to be passed through the solution, until all the lead is thrown down; the free acids are to be separated by filtration, and, on being distilled, are parted from each other, the acetic acid going over, and the caseic acid remaining in a state of purity in the retort.

Caseic Acid is of the colour and consistence of syrup. Its taste is acid, bitter, and like that of cheese. It reddens litmus paper. It congeals into a granular transparent mass like honey. It does not in this state affect lime-water, muriate of tin, or acetate of lead. It precipitates nitrate of silver, white; muriate of gold, yellow; and corrosive sublimate, white; but does not change solutions of those metals, having stronger attractions for oxygen. With an infusion of gall nuts it produces a thick white precipitate.

Chlorine does not change it. Nitric acid rapidly converts it into oxalic acid, forming at the same time a little benzoic acid, and some of the yellow bitter principle. When the acid is distilled it gives the common products of animal matter.

The caseate of ammonia has a sharp saline taste, bitter, and like that of cheese, accompanied ultimately with the taste of roast meat. The salt does not crystallize. It is always acid, and reddens litmus; and if saturated with ammonia becomes acid again by exposure to the air for twenty-four hours. Potash liberates ammonia from it, and forms a compound with the caseic acid, which has no taste of cheese, and which, like the caseate of ammonia, appears incapable of being crystallized.

The caseous oxide may be purified by being boiled in water, and filtered whilst hot; the fluid is to be evaporated considerably, when films and crust of the oxide form. When cold it is to be filtered, and washed with cold water. It is then a light white and spongy substance like the agaric, and future solutions and evaporations do not alter it.

It is so light as to float on both hot and cold water, and the water does not appear to moisten it. It begins to dissolve at about 140° Fahrenheit. It is soft to the touch, crumbles under the fingers, and leaves a peculiar greasy impression when pressed hard. It is tasteless, but its hot solution has a slight taste of the crumb of bread, and emits an odour of the same kind. It is combustible, and produces a white flame.

Boiling alcohol dissolves very little of it, and it separates, on cooling, in crystalline grains. Hot ether does not touch it.

Acids and alkalies do not affect its solution, but potash dissolves it rapidly. Nitric acid dissolves it, and, with the aid of heat, converts it into oxalic acid, and yellow bitter principle.

When moderately heated the greater part of it sublimes, but part, which has been more heated, is decomposed; the results are an abundant yellow oil, which congeals, very little water, and so little ammonia that it requires attention to test its presence. Its charcoal resembles that of distilled oleaginous bodies. The oil produced by this distillation has nothing of the acrid odour belonging to the results of distilled oil, but has a peculiarly fetid alliaceous smell.

These two bodies are also produced abundantly by the curd of milk, during its spontaneous change. According to Mr. Proust, the caseate of ammonia produced in this way, is the odorous and sapid principle of cheese, giving to it its principal characters. Caseous oxide occurs frequently in cheese in detached points, as in those of Gruyere and Roquefort, forming those small particles which affect the teeth, like an earthy and dry substance. A cheese from Villalare gave $\frac{28}{100}$ of a mixture of the acid, the oxide, and a little gum, on analysis. Cheese from Gruyere yielded $\frac{34}{100}$; from Roquefort $\frac{30}{100}$; from Oviedo (a rare cheese) $\frac{36}{100}$. All these extracts were attended with a taste of roast meat, and the remaining part, even of the most savoury cheese, was nothing but a yellow pulp of a stale and nauseous taste.

17. *Pyroligneous Acid.*—The pyroligneous acid, or impure acetic acid, obtained by the distillation of wood and vegetable substances, has been applied, it is said, with great success to the preservation of animal and vegetable substances. Meat plunged for a short time into it may be preserved fresh for many months afterwards, and, when dressed, proves excellent. This effect has been applied to explain the preservation of hams, smoked beef, tongues, sausages, red-herrings, *&c.*

18. *Prize Question in Vegetable Chemistry.*—The subject proposed by the Academy of Sciences, at Paris, for the present year, namely, "to determine the chemical changes which take place in fruits, during and after their ripening," not having been treated according to the conditions annexed to the prize, is again offered to the scientific world for the year 1821. The conditions are, that analyses be made of the fruit at the principal periods of its growth and ripening; also at the time of its decay and spontaneous decomposition. That the nature and quantity of the substances found in the fruits at those times be compared together; and that the influence of external agents on the fruits be examined, particularly that of the air; and also the changes it suf-

fers. The observations may be confined to a few fruits of different species, but so arranged as to allow of general deductions.

The prize is a gold medal of 3,000 francs value, and the time allowed for the reception of papers is till January 1, 1821.

19. *On the Separation of Lime and Magnesia, in a letter from Mr. Cooper to the Editor.*

Dear Sir,—The 12th number of your Journal contains a paper by Mr. Richard Phillips, on the separation of Lime and Magnesia. The method which he proposes consists in washing the mixed sulphates of these earths with a solution of sulphate of lime, which, dissolving the magnesian sulphate, leaves the calcareous one unacted upon.

Admitting Mr. Phillips's discovery of this process, I beg to state, that previous to the publication of his paper, I had not only adopted the method proposed in it, but had employed it in analysing several magnesian limestones, with very satisfactory results.

I am induced to make this claim of priority of discovery, to prevent those chemical friends to whom I imparted it before the appearance of Mr. Phillips's paper, from supposing that I had borrowed it from him, which certainly was not the case; the present instance may therefore be added to numerous others, which show, that those who pursue the same object may attain it by the same means.

It does not however appear by Mr. Phillips's paper that he made any direct experiments upon known quantities of lime and magnesia, to ascertain, if he gets exactly the whole of these substances separated in combination with the sulphuric acid; his experiments went no farther than to prove that a saturated solution of sulphate of lime would dissolve sulphate of magnesia. I carried my experiments further than this, by taking 50 grains of pure crystallized carbonate of lime, and 30 grains of recently prepared magnesia, weighed while it was warm. I dissolved these together in nitric acid, and evaporated the solution nearly to dryness. I then converted the nitrates into sulphates, evaporated, and heated the mass to redness, to expel all the water and uncombined sulphuric acid; the dry mass was then weighed while warm*, which was found to be 158.5 grains. I then powdered it, and poured on it about twelve times its weight of saturated solution of sulphate of lime, which was prepared by boiling recently calcined sulphate in distilled water, and either allowing the excess to separate *per se*, or by the filter; after repeated washing with this solution, the sulphate of lime which remained on the

* It is necessary to weigh the double sulphates before they become cold, or are exposed long to the air, otherwise they combine so rapidly with the humidity of the atmosphere, as to increase their weight many grains.

filter was dried, heated red hot, its weight was found to be 67,8 grains—now if this weight be deducted from that of the joint weights of the double sulphates, we shall have 158.5—67,8= 90,7=the weight of sulphate of magnesia. This accords, as nearly as possible, with the weights we ought to obtain, for if we suppose 50 carbonate of lime, to be composed of 28.4 lime, and 21.6 carbonic acid, and this 28.4 of lime to combine with 39,2 sulphuric acid, this will make the sulphate of lime 67,6, which is a difference of only .2 of a grain, and is as near as we can ever expect to approach by direct experiment.

Again, 30 magnesia combine with 60 sulphuric acid, which will make the sulphate of magnesia, we ought to obtain 90 grains; but by experiment it amounted to a trifle more for 158.5—67.8 =90.7; here there is a difference amounting to .7 of a grain; but I do not conceive in practice, that an error so small, amounting to only $\frac{1}{136}$ part of the whole, can ever be of much consequence; at any rate it approximates much nearer the truth, than by any other mode of operating.

I should here state, that this is not the only experiment I have made, but have repeated it more than fifty times on different artificial and natural compounds, and found in all of them, the results to coincide as nearly as possible.

I am, dear Sir,
Your's respectfully,

89, *Strand, June* 4, 1819. JOHN THOMAS COOPER.

§ 2. METEOROLOGY, ELECTRICITY, MAGNETISM, &c.

20 *Meteoric Stones of China.*

The following account is taken from a paper by J. P. Abel Rémusat, in the *Journal des Sçavans.* It is part of a catalogue of meteoric stones that have fallen in China, made on the authority of *Ma-touan-lin*, and containing an account of about 60 instances.

In the sixth year, *Youan-ho* (811) in the third moon, on the day *Wou-siu*, between the third and fifth hour after mid-day, the sky being cloudy, and the weather cold, there appeared a globe of fire, as large as a *hou* (a measure equal to about 10 bushels,) which fell between *Yan* and *Yun*. A noise resembling thunder was heard at many leagues distance, and the people fled with violent outcry. Above the place where the globe fell, a reddish vapour remained, arranged like a serpent, and a *tchang* (12 feet 6 inches nearly) in length; it remained till the evening, and then disappeared. The twelfth year (817,) in the ninth moon, on the day *ki-kaï*, about the third or fourth hour after midnight, there appeared a running star towards the middle of the heavens; its head was like a bucket, and its tail like a bark of 200 *hou* burthen; it was more than 10 *tchang* (124 feet 8 inches) in length, and made a noise like a number of birds flying; it produced a light similar to that of the torches used in illuminations. It passed

beneath the moon, moving towards the west; on a sudden a great noise was heard, and at the moment the globe fell to the earth, a crash took place thrice as great as that of a falling house.

The second year, *thian-yeau* (905,) in the third moon, on the day *i-tcheoü*, towards midnight, there appeared a great star in the middle of the firmament; it was of the size of 5 bushels; it ran to the north-west side, about 10 tchang (124f. 8in.) when it stopped. There was above it a multitude of small stars, which formed the appearance of a flame, of a red or orange colour, at least 5 tchang (62f. 4in,) in length, and prolonged like a serpent. All these small stars moved towards the south-east, and then fell in the manner of rain. Shortly after which the globe was extinguished. There remained a vapour of a whitish blue colour, approaching to green, which occupied the middle of the heavens; this colour became more and more obscure, and at last disappeared.

In the year *wan-li*, of the dynasty of Ming (1516,) in the twelfth moon, on the 25th day, at *Chun-khing-fou*, in the province of *Sée-tchhouan*, there was neither wind nor clouds, when the thunder rumbled suddenly, and six globular stones fell, of which one weighed 8 pounds, another 15 pounds, and a third 27 pounds; the smaller did not weigh more than a pound, and the smallest of all 10 ounces only.

In the reign of *Wen-tsoung*, king of Corée, which answers to the second year of *thyan-yeau* (905,) there fell at *Hoang-lie* (in Corée,) stones which imitated the noise of thunder. The officers of the place having sent these stones to the court, the president of the ceremonies said, in a petition addressed to the king, that from the time of *Thesin* (he should have said from the time of *Tcheau*,) stars had fallen; and that, under the dynasties of *Tsin* and *Thang*, and, in after times, the same event had occurred from time to time, so that it became a common thing, and not a prodigy, announcing misfortunes or successes, and that it ought not to occasion astonishment.

Certain stones, of a black or violet colour, are called thunder hatchets, scissors, hammers, wedges, gimblets, rings, pearls of thunder, or rather of the god of thunder. Their form approaches a little to the objects after; which they are named, and it is reported that they fall with the production of thunder. The hammers sometimes weigh many pounds, and the wedges are a *tchhi*, or Chinese foot, in length. All these objects resemble steel or iron. Many wonderful histories are told of them, but the Chinese author, from whom the above instances are taken, rejects all these, and explains them according to the phantastic principles of Chinese philosophy. His most sensible observation is, that these supposed tools of the god of thunder are of the same nature with falling stones. In the history of Japan it is recorded, that in the sixth year, *siowa*, of the reign of *Nin-Mio Ten-O* (839,) the 29th

day of the eighth moon, there occurred at a place to the west of the town of *Thean-tchhenan*, where no fragments of stone previously existed, thunder and rain for ten days. The weather having become clear, stones similar to the points of arrows and to hatchets, were found on the earth, some being white and others red. There is another example of similar observations made in two other towns of Japan, and which were renewed during three succeeding years, in the reign of *Koucko-Ten-O*, in the years *nenwa*, *i. e.* in 885, 886, and 887.

It is said in Japan, that thunder stones are much more common towards the north, than in Japan, where they are somewhat rare, and some insufficient proofs of this are given. Another conclusion may be drawn from these Chinese and Japanese accounts, more remarkable, and of greater value, namely, that in the greater number of cases the *lieou-sing*, or the ignited globe, which produced the falling stones, has been observed before their fall, and appeared to be the immediate cause from which they originated.

21. *Meteors.*—A very remarkable meteor was seen at Aberdeen, on Wednesday, May 5th. At about half past 12 o'clock in the day it appeared at an altitude of nearly 36°, having the form of a ball of fire, with a short tail, darting towards the earth. The atmosphere was uncommonly clear at the time, with bright sunshine, and no clouds. In about *five minutes* after it was observed, it exploded with a considerable noise, and a volume of smoke issued from it, which assumed the form of a small white cloud. The same meteor was seen in many parts of the country. In the parishes of Kintore, Fintray, &c., the noise of the explosion was so loud that the cattle in the fields became terrified, and bellowed loudly.—Scotsman.

On the 5th of June, a remarkable meteor was seen near Lowick, in the neighbourhood of Berwick, at about five minutes past 12 at noon, the sun shining bright at the time, and the sky clear; it had the appearance to the observer, when first noticed, of a brilliant ball of fire, and afterwards appeared like a flaming sword, pointing downwards towards the earth, in a direction above Berwick; its course appeared to be northerly, and at a great distance from the earth.—Chronicle.

22. *New Hygrometers.*—Mr. Adie proposes, in a paper printed in the *Edinburgh Philosophical Journal*, to use the internal membrane of the arundo phragmites in the construction of hygrometers, by forming it into a bag at the end of a fine tube, and then filling it and part of the tube with mercury. Instruments made in this way are described as extremely sensible, and very uniform among themselves, though liable to changes, resulting from variations of temperature, and the natural tendency of or-

ganized matter to alter. The former influence, Mr. Adie states, is considerably counteracted by making the glass tube go through the bag, to which it is tied above and below, and causing a lateral communication for the mercury by some holes in the side of the tube. Portable hygrometers may be made, by attaching a slip of the same membrane to the end of a lever, which then marks, in a magnified degree, the extent of its contraction and expansion.

Mr. Livingstone, of Canton, describes, in the same Journal, an application made by him of the old hygrometrical substance, sulphuric acid, to the same purpose. Having observed, in the process of making ice, that the power of the sulphuric acid was remarkably equal, from the point of its highest concentration, until it had been used twelve or fifteen times, he hoped it might be so in a more diluted state, and, finding it answer his wishes, he constructed a hygrometer in the following manner: A small porcelain dish, containing 21 grains of sulphuric acid, of 1.845, and 29 grains of water, were balanced, and, being exposed to air, of the greatest degree of artificial moisture, gained 50 grains in 24 hours; afterwards placed for a night, in a close vessel, over concentrated sulphuric acid, it lost 50 grains. Half a grain made the edge of the scale of the balance describe an arch exceeding an inch, both above and below the level; the whole space, equivalent to a grain, was divided into 20 parts, and this, multiplied by the difference of 50 grains, gave a scale of 1,000°, between the extremes of moist and dry. When used, the instrument was placed under a glass cover, sufficiently open below to admit the air freely, and Dr. Livingstone expresses his conviction of its superior accuracy to any other. It frequently, in the atmosphere, approached within a few divisions of the point of greatest humidity, and also within 143 of extreme dryness. Another mixture of 2.1 grains of acid, and 2.9 grains of water, gave a scale of 100°, and was very sensible. A remarkable instance of rapid change in the hygrometrical state of air, is noticed, as observed by this instrument. It pointed to 950° (or the mixture weighed 9.5 grains,) at Macao, on the 7th of Feb. 1817, as the time of a very thick fog; it continued so that evening, but next morning, at 7 o'clock, the wind having changed during the night from S. W. to N. E., it had lost 4.5 grains, or had fallen to 100°.

Glass covers to the pans, and other additions, are suggested as tending to prevent the interference of dust or any other disturbing causes.

23. *Earthquakes.*—1. On the 2d of October last, about half-past 1, P. M., a very smart shock of an earthquake was felt at Brutensorg, Batavia. The houses were violently shaken, the windows rattled, the mortar fell from the walls, and the bells rung; people who were standing up became giddy by the motion of the ground. Some houses had the walls rent open. The shock lasted only a few seconds. It was felt in the mountains as well as in Batavia.

On the night of January 29th, several shocks of an earthquake were felt at Tefflis in Georgia; they were preceded by tempestuous weather and subterranean noises. About 10 o'clock they became very violent, the earth was rent in many places, and many old buildings were destroyed.

On the 26th of February, an earthquake was felt at Rome, Frescato, and Albano. Its direction was from S.E. to N.W.

A letter from Palermo of the 4th of March, states that during the fourteen preceding days, the weather had been dreadful, and that three shocks of earthquakes had occurred. Much mischief was done by the shocks on the south-east part of the island, churches being thrown down and villages destroyed. Much damage was also done among the shipping; but none occurred at Palermo.

Three shocks of an earthquake were felt at Temeswar, in Hungary, on the 8th of April.

A slight shock of an earthquake was felt at Landshut and Augsburgh, on the 10th of April.

It is stated, in accounts from Rome, that a violent shock of an earthquake was felt at Corneto on the 26th of May, which considerably damaged several edifices, but no lives were lost. The celebrated Cupola il Castello, remarkable for its antiquity and its Gothic architecture, was thrown down, and the church of the Minor Friars, of which it formed a part, was so much damaged as to be rendered useless for the present. The shock is stated to have been felt along the whole coast of the Mediterranean.

24. *Pyro-Electricity of the Tourmaline.*—The electricity of this mineral may be shewn in a very satisfactory and beautiful manner, by means of a thin slice taken from any part of the prism. In order to perform the experiment with most advantage, the slice should have its surfaces perpendicular to the axis of the prism; it must then be placed upon a piece of well-polished glass, and the glass heated to a considerable degree: at the proper temperature, which is about that of boiling water, the slice will adhere to the glass so firmly, that even when the glass is above the tourmaline, the latter will adhere to it for 6 or 8 hours. By this means, slices of a very considerable breadth and thickness develope as much electricity as is capable of supporting their own weight. The tourmaline adheres also to all *metallic* bodies, to wax, and all minerals that have been tried.

Mr. Sivright has fitted up a tourmaline, so as to bring the action of its two poles very near to each other. It resembles the letter D with an opening on the curved part; the straight part represents the tourmaline, and the two curved parts are pieces of

silver wire, rising out of two silver caps, one of which embraces each end of the tourmaline. When a pith ball is suspended at the opening between the extremities of the wires, it will vibrate in a very beautiful manner.—*Edinburgh Philosophical Journal.*

25. *Magnetism by Light.*—The discovery of M. Morrichini is so curious, and would be, if established, so important, that it is necessary to prevent if possible any erroneous opinion on the subject, by making known every experimental authority both for and against it. Dr. Carpi, Count Ridolfi, and Mr. Playfair, have succeeded in getting results in harmony with those of M. Morrichini, but others have tried in vain. M. Dhombres Firmas has lately published an account of his experiments, which were unsuccessful, though made apparently with all possible caution, and varied according to the directions of the above-named philosophers.

III. Natural History.

§ 1. Botany.

1. *Tea-Shrub at Katmandu.*

Extract of a letter from Calcutta, (29th October, 1818.)—The British Resident at the Court of Nepal (Hon. E. Gardner), has lately discovered a fine *tea-shrub*, in the garden of a Cashmirian, at Katmandu, originally brought from China, and growing with vigour, and producing ripe seed yearly. He has also found a species of Camellia, on the mountains of *Sivapur*, where the tree is called *Kísí*. It resembles, as very properly remarked, the real tea; and comes very near to Thunberg's Camellia Jakanqua, but differs in the fruit.

The utmost exertions will be used to effect the introduction of those invaluable trees, into such of the British possessions, towards the north and west, as may hold out prospects of success in their cultivation.

Specimens of Valeriana Jatamansi (Spikenard) and Gentiana Chirayta, have been received from *Gosain-than*, a wild and desolate place at the foot of the *Himálaya* mountains, situated to the northward from Katmandu, seven or eight days journey thence, and greatly elevated above the valley of Nepal.

From the same quarter, a very great number of undescribed plants, not less than twelve hundred new species, have been received at the Botanic garden—both dry specimens, and growing plants, or ripe seeds. Among those particularly mentioned, are some splendid Incarvilleæ, several Gerania, and Convallariæ, innumerable Orchidæ, and some fine Liliaceæ; especially a stately one-flowered nutant Lily, approaching to the Lilium Japonicum of Thunberg.

These productions of the cold and rugged regions, at the foot of the snowy mountains, may be expected to prove hardy plants,

capable of sustaining the rigour of an English climate, when introduced, as doubtless they will be, into Great Britain; where many will be found useful objects of culture, and others ornamental.

Among useful plants may be specified kitchen-garden ones, indigenous of Nepal; such as the immense *Newar* radish, and a cucumber, of which a specimen in the Botanic Garden, measured 17 inches in length, 25 in girth, and weighed 507 sicca weight, (12½ lbs.)

§ 2. Mineralogy, Geology.

2. *English Gold.*—Some fine specimens of native English gold have been presented to the Royal Institution, by Sir Christopher Hawkins, Bart., through the hands of Earl Spencer. They were found lately whilst streaming for tin, in the Parish of Ladock, in Cornwall: some of the pieces weigh each 60 grains.

Native English gold has also been found lately in Devonshire, by Mr. Flexman, of South Moulton. It occurs in the refuse of the Prince Regent mine, in the Parish of North Moulton; the mine was discovered in 1810, and worked for copper, but was discontinued in May 1818. The refuse is a ferruginous fragmented quartz rock, and contains the gold in imbedded grains and plates. Gold has been reported to be found in some other mines in that neighbourhood.

3. *Native Copper.*—A remarkable piece of native copper, was lately found near the town of Wallingford, twelve miles from Newhaven, United States. The country is according to the Wernerians of the secondary trap formation, and the rocks at the place where it was found are of the old red sandstone, which here occupies the plains, and runs under the trap. The piece, which was turned up in ploughing, weighed almost six pounds. It was virgin copper, with rudiments of large octoedral crystals of native copper on its surface. It was more or less incrusted with green carbonate of copper and ruby oxide, very much resembling that of Cornwall. A piece of nearly 90 pounds weight was found in the same neighbourhood several years ago.

4. *Analysis of a Stone used in the setting of fine Cutlery.*—In the Supplement to the *Encyclopædia Britannica,* article Cutleyr, mention is made of a green stone as the only known material capable of giving to lancets, and other delicate instruments, the smooth and perfect edge, that is essentially necessary to their performance: this valuable material is stated to be found in some parts of the old pavement of London. Being furnished with a very fine specimen, by my friend Mr. Stodart, I, at his request, submitted it to an analysis, and obtained the following proportions per cent:

Water	3.33
Silex	71.33
Alumine	15.33
Protoxide of Iron	9.33
Trace of Lime.	
	99.33

In consequence of the great value of these stones when very good, the piece from which the above numbers were obtained was but small, weighing only 15 grains; but from the analysis having been twice made, and from the added numbers approximating so nearly to the quantity operated upon, I have no reason to doubt the correctness of the result. The stone itself is a soft hornstone.

M. Faraday.

5. *Analyses of some Minerals containing Lithia, by M. Arfwedson.*

Petalite from Uto' specific gravity, 2.421

Silex	79.212
Alumine	17.225
Lithia	5.761
	102.198

Triphane from Uto'

Silex	66.4
Alumine	25.3
Lithia	8.85
Oxide of Iron	1.45
Volatile matter	45
	102.45

M. Arfwedson observes that he does not know how to explain the surplus which occurs in these two analyses, but that he is certain they do not come from impure tests, and that every care was taken in the washing and other manipulations.

Green Tourmalin, or crystallized Lepidolite.

Silex	40.30
Alumine	40.5
Lithia	4.3
Oxide of Iron	4.85
Oxide of Manganese	1.5
Boracic Acid	1.1
Volatile Substances	3.6
	96.15
Loss	3.85
	100.00

Afhandlingar i Kemi Fysick och Mineralogie, T. 6.

6. *Analysis of the Garnet from Fahlun.*—M. Hisinger finds the large garnets which come from the copper mine of Fahlun, to be composed of

Silex	39.66
Alumine................	19.66
Protoxide of Iron	39.68
Oxide of Manganese......	1.8
	100.8

7. *Temperature in Mines.*—The curious observations made by Mr. Lean, on the increase of temperature in descending into the mines in Cornwall, were noted at page 371 of the last volume of this Journal. The following data of a similar kind are taken from a paper by Mr. Bald, in the *Edinburgh Phil. Journal.*—At Whitehaven Colliery, Cumberland; water at the susface was 49°; at the depth of 480 feet, 60°; giving a difference of 11°. Workington Colliery, Cumberland;—A spring at the surface 48°. Water at 180 feet from the surface 50°; at 504 feet, where it was beneath the water of the Irish sea, 60°; making a difference of 12°. Teem Colliery, Durham;—Average temperature of water at the surface 49°; water 444 feet deep 61°, difference 12°. Percy Main Colliery, Northumberland;—Average temperature of water at the surface 49°; at a depth of 900 feet from the level of the sea, and beneath the bed of the Tyne, 68°, difference 19°. Jarrow Colliery, Durham;—Average temperature of water at the surface 49°; water at the depth of 882 feet, 68°; difference 19°. Killingworth Colliery, Northumberland;—Average temperature of water at the surface 49°; water at 1,200 feet from the surface 74°; difference 25°.

It is observed, with respect to the extraordinary depth of the last mine, that the temperature of boiling water at the bottom of it was 213°.

§ 3. Medicine, Anatomy, &c.

8. *Medical Prize Question.*—The Medical Society of Paris has proposed the following question; for the best reply to which a prize of 300 francs in value will be awarded in December 1819. "Is there any doubt respecting the existence of idiopathic fever?" The memoirs are to be written in French or Latin, and sent, free of expense, to M. Nacquart, Secretary to the Society, Rue Sainte Avoie, No. 39, before the 1st of November.

The subject proposed last year by the Society, "To determine the nature, causes, and the treatment of internal hæmorrhages from the uterus, arising during pregnancy, in the course

of parturition, and after delivery, not having been satisfactorily treated, it is again proposed for the present year, the premium and other circumstances being as above.

The Medical Society of the Department of the Eure has proposed the following question :—"To determine the nature, character, causes, differences, and treatment of ascites." The prize a gold medal of 200 francs value; and a silver medal to the author of the second best memoir. The papers, written in French or Latin, are to be sent to M. L. H. Delarue, Pharmacien à Evreux, before the 1st of August, 1819.

9. *Anatomical Prize Question.*—The Royal Academy of Sciences of Paris have announced the following subject of a prize essay. The reward to be a gold medal of 3,000 francs value, to be adjudged in March 1821.

"To give a comparative description of the brain of the four classes of vertebral animals, and particularly of reptiles and fishes, endeavouring to discover and establish the analogy of the various parts of this organ, describing with care the changes of form and proportions which it suffers, and tracing to the utmost the roots of the cerebral nerves. It will be sufficient to make the observations on a certain number of particular genera, chosen from among the principal natural families of each class; but it is required that drawings be given of the principal preparations, so accurate as to enable others also to prepare them, and verify the observations."

The papers are to be sent to the Secretary of the Academy, free of expense, before January 1, 1821, each having a motto, or design, which is to be repeated on a sealed note, containing the name of the author.

10. *Animal Magnetism.*—It is curious to observe the different feelings with which this pretended science is received on the Continent. In Austria, at the latter end of last year, all those physicians, not matriculated at the University of Vienna, were called together, in order to be officially informed of a resolution taken by the supreme powers, by which the practice of animal magnetism is generally prohibited throughout that country; and several of the doctors of Vienna have been publicly censured as empirical practitioners of the art, and threatened with suspension of their functions, should they still resort to it. On the contrary, in Prussia it is encouraged, and the class of physical sciences of the Academy of Berlin has proposed, by order of the Prussian government, a prize of three hundred ducats for the best explication of the phenomena of animal magnetism, and of the experiments made down to the latest period, divesting them of the marvellous which has hitherto been mingled with them. It is to be feared, that thus purified, the science itself will disappear.

IV. General Literature.

1. *Pompeia.*—The workmen employed in making researches among the ruins of this celebrated city, have lately discovered a bronze vase, incrusted with silver, the size and form of which place it very forward amongst the articles of this description which form so interesting a part of the Bourbon Museum, and also a bronze statue of Apollo, of admirable workmanship, which is indisputably the finest in the gallery. The beauty of form, and the life of the figure, is described as being beyond description. The deity is represented as sacrificing, with his avenging arrow, the family of Niobe.

2. *Roman Medals.*—On the 1st of March, some monks of one of the convents of Namur, working in a piece of ground belonging to the convent, found, about a foot under ground, a vessel of baked earth, which contained about 2,000 Roman medals or coins. Most of them are of bronze, and some of silver. Among these medals there are some of Gallienus, of Gordian, Claudius, &c. They are in the possession of the directors of the convent to whom the monks delivered them. The place where they were found is a small hillock, on the left bank of the Meuse, about a quarter of a league from Namur. The vessel was broken into a multitude of small pieces.

3. *Hieroglyphics in Sweden.*—M. Brunins, of the university of Lund, in Sweden, has discovered a considerable number of inscriptions cut in rocks, and which, according to the best judgment that can at present be formed of them, appear to be hieroglyphics of very remote antiquity. A programma of these has been published, and a more detailed work on the subject is expected.

In connexion with the supposed characters on what have been called the written rocks, in the state of Massachusetts, North America, these hieroglyphics possess considerable interest. They may perhaps determine whether those in America are really the results of art, or only the accidental effects of water. If, however, they do not clear up this point, they will still be very important for their own sakes, and for the illustrations they will offer of the progress of written language.

Art. XXIII. METEOROLOGICAL DIARY for the Months of March, April, and May, 1819, kept at Earl Spencer's Seat at Althorp, in Northamptonshire. The Thermometer hangs in a north-eastern aspect, about five feet from the ground, and a foot from the wall.

For March, 1819.

		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Monday......	1	32	37	29,24	29,27	E	NE
Tuesday	2	33	39	29,31	29,43	NE	NE
Wednesday ..	3	34	41	29,55	29,72	NE	ENE
Thursday....	4	32	44	29,85	29,90	NNE	N
Friday	5	36	45	29,94	29,90	NE	NbE
Saturday	6	40,5	47	29,86	29,90	NE	NE
Sunday	7	40	47,5	30,00	30,08	NE	NE
Monday......	8	38	43,3	30,08	30,05	NE	NE
Tuesday	9	34	50	30,03	30,03	NW	W
Wednesday ..	10	43	48	30,03	29,98	W	NW
Thursday....	11	39	50	30,00	30,00	NW	WNW
Friday	12	38	48	30,20	30,12	W	NW
Saturday	13	42	47	30,29	30,20	W	NW
Sunday	14	41	48	30,20	30,19	W	SW
Monday......	15	39	52	30,22	30,00	SW	SW
Tuesday......	16	42	56	29,09	29,89	SW	WbS
Wednesday ..	17	41	44	30,00	30,04	W	WbN
Thursday	18	29	45	30,10	29,97	WbN	W
Friday	19	36	48	30,47	29,28	SW	W
Saturday	20	37	46	29,30	29,50	WbN	W
Sunday	21	34	45	29,70	29,70	NW	NW
Monday......	22	35	48	29,70	29,67	W	W
Tuesday......	23	37	58	29,60	29,57	SE	S
Wednesday ..	24	43	54	29,40	29,47	SW	W
Thursday....	25	39	51,5	29,49	29,42	WbS	W
Friday	26	38	51	29,64	29,74	WbS	SW
Saturday	27	44	52	29,74	29,68	SW	SW
Sunday	28	43	55	29,60	29,60	SW	SW
Monday......	29	41	57	29,55	29,55	SW	SW
Tuesday	30	43	57	29,77	29,80	W	SW
Wednesday ..	31	49	63	29,90	29,93	W	WbS

For April, 1819.

		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Thursday	1	47	62	29,97	30,00	SW	SW
Friday	2	46	58	29,98	30,00	NW	E
Saturday	3	38	60	29,90	29,90	NW	E
Sunday......	4	42	56	30,00	30,00	EbS	SE
Monday......	5	39	54	30,00	29,93	W	E
Tuesday	6	34	54,5	29,87	29,81	E	E
Wednesday ..	7	46	62	29,57	29,57	E	EES
Thursday....	8	48	60	29,70	29,80	E	NW
Friday	9	36	55	29,87	29,90	W	W
Saturday	10	37	58	29,90	29,80	W	W
Sunday......	11	41	58	29,30	29,20	W	SW
Monday......	12	32	56	29,20	29,20	SE	NE
Tuesday	13	44	49	29,13	29,22	E	W
Wednesday ..	14	36	54,5	29,37	29,33	SE	SW
Thursday....	15	39	55	29,30	29,20	W	SSW
Friday	16	43	57	29,02	29,10	E	WbS
Saturday	17	42	52	29,17	29,27	W	SW
Sunday......	18	40	54	29,47	29,52	SW	W
Monday......	19	36	53	29,62	29,70	SW	SW
Tuesday	20	46	55	29,48	29,52	E	S
Wednesday ..	21	46	59	29,70	29,57	SW	W
Thursday....	22	41	57	29,73	23,78	NW	NE
Friday	23	40	48	29,55	29,64	E	NE
Saturday	24	43	50	29,77	29,60	E	NE
Sunday	25	41	46	30,07	29,90	E	NE
Monday......	26	32	51	30,07	30,05	NE	NE
Tuesday	27	32	51,5	30,05	30,10	NE	E
Wednesday ..	28	29	56	30,10	30,07	SE	ESE
Thursday....	29	32	59	30,00	29,90	SE	E
Friday	30	32	59,5	29,85	29,75	E	SE

For May, 1819.

		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Saturday	1	35	63	29,71	29,68	SE	SE
Sunday	2	42	68	29,63	29,57	SE	SE
Monday......	3	49	70,5	29,54	29,50	SE	E
Tuesday	4	51	63	29,48	29,43	SE	E
Wednesday ..	5	49	64	29,43	29,54	SE	SE
Thursday....	6	42	65	29,77	29,87	SSE	S
Friday	7	40	66	29,90	29,90	SbW	NW
Saturday	8	30	71	29,98	29,98	NE	ESE
Sunday	9	47	73,5	29,98	29,98	SE	SW
Monday......	10	44	70	30,04	30,04	W	W
Tuesday	11	53	69	30,01	30,00	SW	W
Wednesday ..	12	48	71,5	29,98	29,95	W	W
Thursday....	13	46	65	29,95	29,95	W	WbN
Friday	14	41	63	30,00	30,08	W	W
Saturday	15	39	69	30,00	29,90	W	E
Sunday	16	44	71	29,90	29,89	W	SW
Monday......	17	39	71	29,89	29,75	S	SW
Tuesday	18	43	70	29,67	29,69	SW	W
Wednesday ..	19	50	55	29,65	29,49	SE	NE
Thursday....	20	48	55,5	29,48	29,50	N	WNW
Friday	21	47	60,5	29,48	29,48	NE	SE
Saturday	22	42	62	29,56	29,60	E	SE
Sunday	23	38	71	29,80	29,80	E	E
Monday......	24	49	67	29,80	29,88	E	E
Tuesday	25	47	57	29,86	29,80	NE	NE
Wednesday ..	26	46	57,5	29,80	29,88	NE	NE
Thursday....	27	43	62	29,80	29,72	NE	NW
Friday	28	40	59,5	29,79	29,80	NE	NbW
Saturday	29	34	58	29,80	29,84	NW	NE
Sunday	30	31	59,5	29,86	29,86	W	W
Monday......	31	44	65,5	29,95	29,95	W	W

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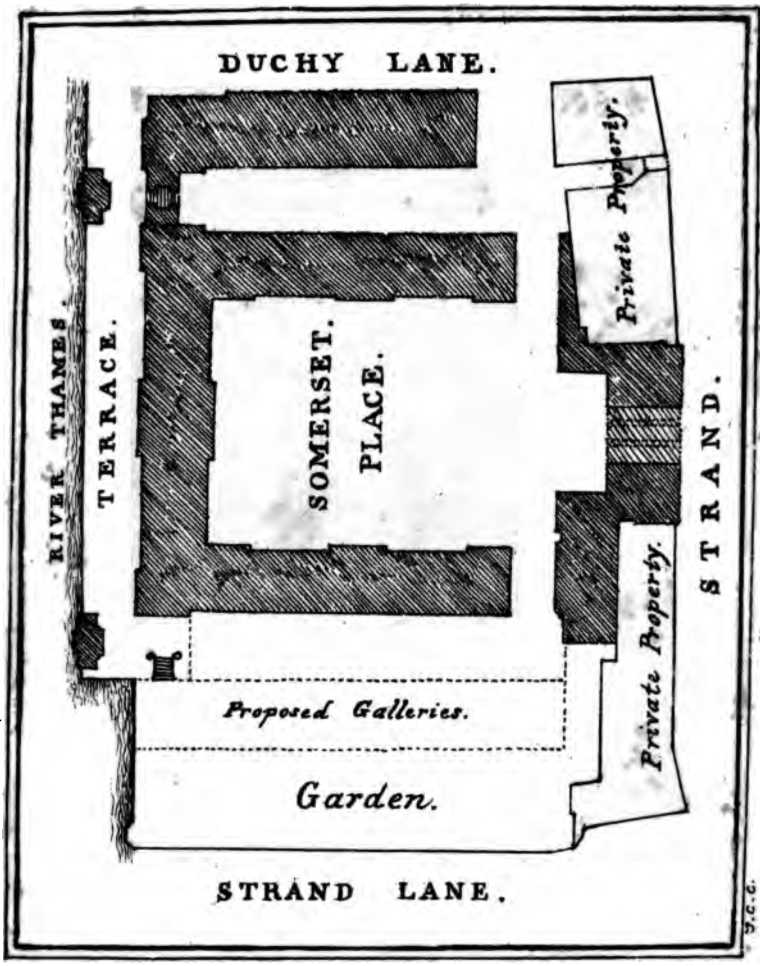
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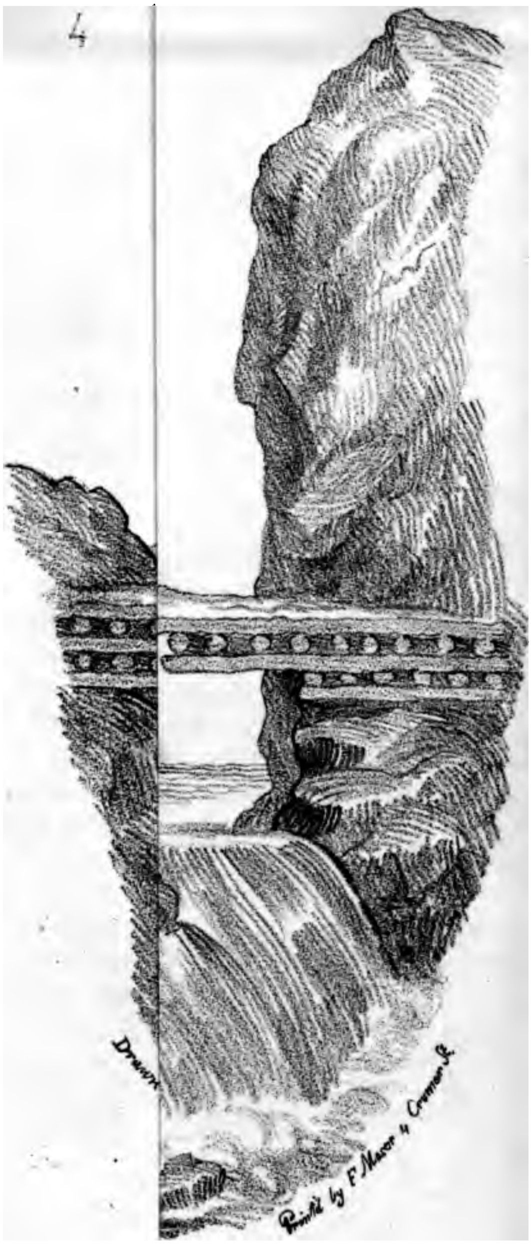

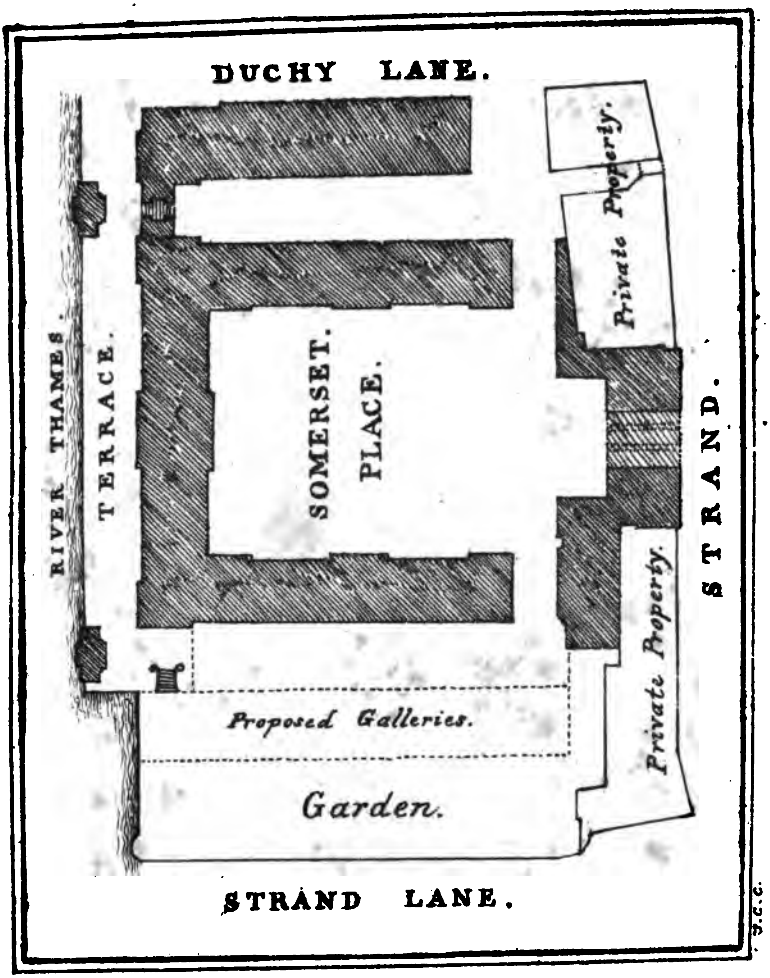
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